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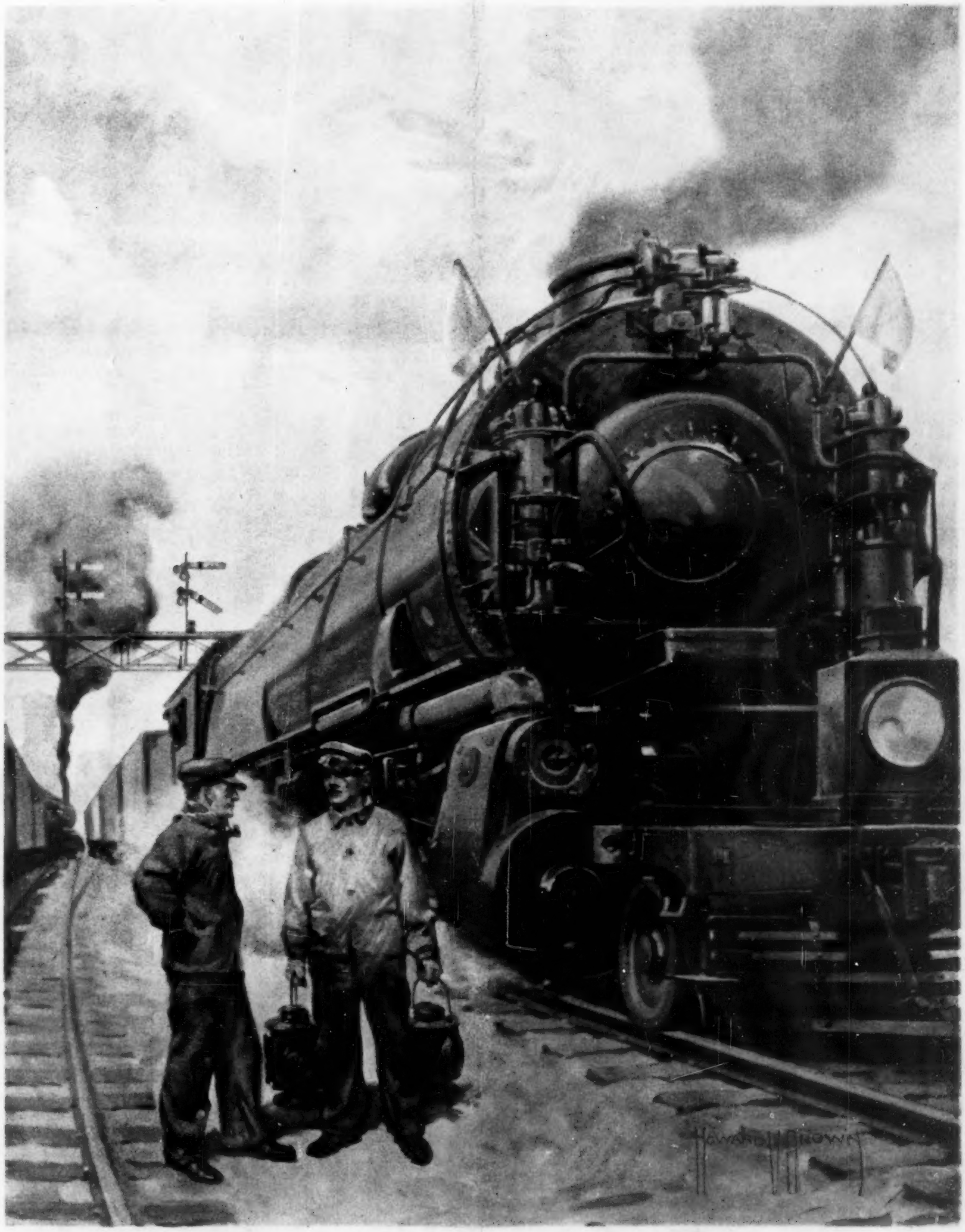

RAILROADING WITH THE GIANT LOCOMOTIVES OF 1919.—[See page 250]

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SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

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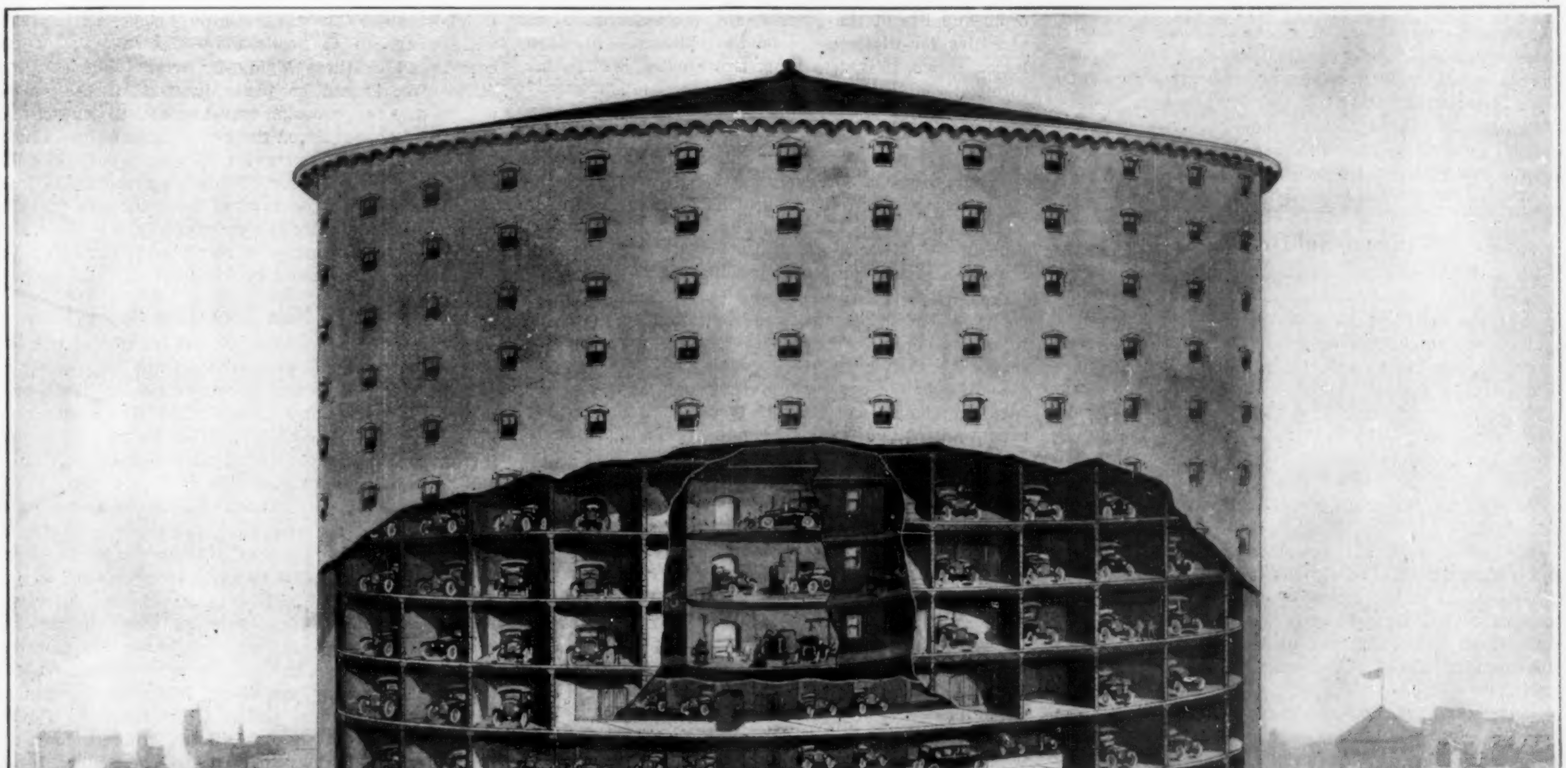

Spiral skyscraper garage for parking motor cars in large cities –[see page 259]

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Sense of Discipline

IT has been charged against us, the American people, that we are lacking in a sense of discipline. If the criticism came solely from outside alien sources, we might ignore it as being due either to prejudice, superficial knowledge, or the lack of that well-balanced judicial mind, which is necessary for a just estimate of one people by another. But no one who keeps himself thoughtfully abreast of the times can fail to have noticed that the severest charges of a lack of discipline among the American people have come from the American people themselves. We stand self-convicted.

The latest prominent American to call attention to this national fault is Brig.-General W. W. Atterbury, vice-president of the Pennsylvania Railroad Company, lately returned from France, where he was Director General of Transportation of the American Expeditionary Forces. In the course of an article in the Baltimore and Ohio *Employees' Magazine* on the relative merits of foreign and American railroading, he states that in his opinion, on the whole, the operation of our railroads is even safer than those of France, because of our highly-developed methods of train dispatching, our superior signal systems, and the general and increasing use in this country of steel or steel-underframe passenger cars.

General Atterbury then goes on to speak of the matter of discipline and says: "The French, and the Germans, too, for that matter, are much more highly disciplined than our Americans; they have greater respect for laws and regulations. As you know [he is writing in an employees' magazine] it is the breaking of the rules of our American railroads that is so often the cause of our accidents."

This recalls to our mind the fact that some fifteen years ago, when this journal was trying to awaken the country to a realization of the frightful number of accidents which were occurring on our railroads, Colonel Wilgus, who was then Chief Engineer of the New York Central Railroad, informed us that a large proportion of the railroad accidents were attributable to lack of discipline, as shown in the deliberate breaking of the prescribed rules of the system.

Why, as a people, are we thus open to the charge of lacking a strong sense of discipline? Why do we allow to go unchallenged the statement that, no sooner have we made a law than we set about to find the safest way to break it? Some will answer that it is the penalty we pay for our independence of character—others that it is to be found in the laxity of the parents, who, too often, fail to understand that instant obedience and a profound respect for authority should be among the very first lessons impressed on the mind of a child.

Both of these explanations are, doubtless, correct; and the one is the outcome of the other. The so-called independence of the youth and the grown man is the matured product of the indulgent but hurtful lack of discipline in the training of the child. Moreover to apply the word independence to a fast-and-loose observance of the laws is a misuse of terms; for there is no incompatibility between a manly independence and a loyal acceptance of the obligations of the law. Had the average American youth, who found himself suddenly thrust into khaki, received in his early childhood that careful training in prompt obedience to parental authority, which is one of the most valuable preparations for effective and useful service in after life, the burden of military service would have rested more lightly on many a broad pair of shoulders.

Among the valuable assets of the war are the object lessons which America has both given and received in her intimate contact, man to man, with the peoples of the older races from which we have sprung. Respect for law and order, as exemplified in the precepts and life of the parents, and the enforcement of penalties for disobedience on the children—here is a lesson which, if laid to heart and applied, will go far to offset the sacrifices we have made.

Who Shall Own the Cars?

IN the construction of our railroad systems, it was not possible for every local center of manufacture or trade to be on a trunk line; some of them had perforce to be left out in the cold. The obvious remedy for this misfortune of being left off the railroad is a short branch line tapping the affected territory. When the railroad was not inclined to build such a line, local capital, more optimistic with regard to the ultimate destiny of the region, frequently got together and built its own feeder.

Such a line, of course, is of value only as it connects with the channels of through transportation. Nobody ever wants to go or to send goods from Ironville to Ironville Junction, save as the junction gives him access to the world beyond. So the Ironville Branch is a feeder line pure and simple; and whatever its ownership, it can in operation be nothing more than an appurtenance of the big road. In many cases the big road promptly took advantage of this operating dependency to secure financial control as well, and at its own figures. The procedure was simplicity itself.

The little road must deliver at the junction carload lots of whatever goods are produced along its line. The big road hauls these off to their destinations at the seaboard or the centers of consumption. But in some mysterious manner, the returning empties would never return to the junction. The little line could not get back by loading the cars delivered to it with incoming freight; for if the local center were any good at all it would use more outgoing cars than incoming, while the big line was not under obligation to accept loaded foreign cars unless they were billed in the general direction that would take them back home. There was no remedy in protest; for this would be ignored until it came to a showdown, when the sidings at the junction would be flooded with a vast quantity of cars, and a peremptory demand issued that the little road haul them off and load them up and send them back. For the little road, as badly off with more cars than it could handle as it was with none at all, there was never discovered any way out; it was a clear case of sell out at the other fellow's figure, or be prepared to go on indefinitely supplying rolling stock for all the railroads in the country.

We drag up this chapter in the history of railroad high finance because of the analogy between it and what is now going on in the packing industry. Why is there a Big Four that controls practically all the meat sales of the country? The answer to that question is to be seen in any passing freight train. The ordinary box cars bear the marks of the various railroads; but the refrigerator cars, in which alone meat can be shipped, do not belong to the roads at all—they are the property of the shippers, as the imprints painted on them will testify.

Years ago the first of the big packers introduced this custom of providing his own cars to ship his goods in. Competitors fell in line. The railroads were willing enough to be relieved of the burden of providing this special class of equipment; soon it became difficult, at length utterly impossible, to find a road that could, on its own resources, care for meat shipments. This means, of course, that unless you have the cars you can't ship these products. It means that you can't buy them except from those who have cars. It means that if you are a producer of meats, you cannot find your own markets unless you are able and willing to enter into the railroad-car business also. And if the little fellow attempts to do this, he stands just where the little roads stood fifty years ago. His cars are not delivered to their destinations and they are not returned to him as they should be.

Now, the big packers have a pretty good bill of health in connection with the present price of food to the consumers. That is not the point. There exists here a monopoly which is utterly indefensible on every ground of public policy. It should be possible for any man who can pay the freight to ship meat just as freely as he can ship anything else. It is on this ground that the Federal Trade Commission recommends that the Government initiate some course which will restore to the railroads the ownership of the cars in which these highly important shipments are made. We should be justly incensed if the use of private cars for passenger travel became so general that the railroads abandoned their coaches and the Pullman Company gave up its service, so that nobody who did not own a private car of his own could get himself hauled about the country by a locomotive. The same objection applies to a state of affairs under which nobody but the owner of a refrigerator car can get a certain class of commodity transported.

Lessons of the New York-Toronto Air Race

AS a race, the recent New York to Toronto and return flight possessed all the elements that go to make a real sporting element. There were numerous contestants, several surprises, some accidents, and at least one big thrill in the form of a missing airman, who reported his mishap some time later. But the real significance of the race was in the shape of the competition between various machines and motors, which, for the most part, had never been pitted one against the other in order that there might be some conclusions drawn as to their relative merits.

Well, to make a long story short, the American-built DeHaviland-Four, equipped with the Liberty motor, proved to be an excellent all-round machine. The list of machines to finish the return trip, arranged according to flying time, shows DeHaviland machines occupying the first five places, a LePere machine sixth, two more DeHaviland machines, and further down the list a DeHaviland here and there. The winner, Lieut. B. W. Maynard, made the complete journey back and forth in 465½ minutes, or at an average speed close on to 2¼ miles a minute in his Liberty-motored DeHaviland-Four. What is perhaps more remarkable than the very remarkable speed made by Lieut. Maynard, is the fact that his machine flew without mishap or adjustment of any kind. His motor, running at 1,825 revolutions during the two-way trip, performed faithfully and without nursing, so to speak. Indeed, his flight was devoid of anything spectacular, and as a sporting proposition its only thrill was the exceptionally fast time.

There were 52 entries for the flight, and 28 finished the round trip. Three made second starts after failing in a first attempt. Several airmen received injuries at the start or in landing, the latter class of accidents being largely due to poorly prepared landing fields. All in all, the New York-Toronto air race is a distinct victory for the American-built plane and engine, as well as for our airmen who have served in the military and commercial establishments of the country. Like nothing else it has served to stimulate interest in aviation both as a sport and as a commercial proposition.

It's an Ill Wind

PROHIBITION in the United States seems to be proving of benefit to Cuba's staple industry—sugar. It is claimed that more than 100,000 tons per month are used in excess of ante-prohibition consumption. A record sugar crop is predicted for this season. This increase in exports is leading to additional industrial and commercial prosperity. Railroads and large buildings are being constructed in many parts of the island. Locomotives for the new lines are being bought to a considerable extent in the United States.

Naval and Military

Disarmament in Earnest.—Following closely upon the amazing reduction which Great Britain voluntarily made in her naval armaments (disarmament was merely suggested in the provisions of the League) when she got rid at one stroke of 150 warships including all of her predreadnoughts, and stopped work on all capital ships, a cable dispatch has appeared stating that she has now stopped work on *all* warship construction. The dispatch needs verification; for there must be many nearly-completed ships in British yards which it would be better economy to launch and fit out.

Make Haste Slowly.—It will be deplorable if, in our rebound from the enormous scale of our war preparations, we should swing to the opposite extreme of neglecting to maintain our military establishment on a plane of adequate and permanent preparedness. Yet that very condition threatens, and it should be the duty of Congress and the public press to warn the country against this very danger. The present heavy taxes are in a very true sense the measure of our former neglect and unpreparedness. Had we listened to the warnings of the General Staff in the years preceding the war, its cost in men, equipment and especially in artillery would in all likelihood have been cut in half.

A Legacy of the War.—So far as the army is concerned, perhaps the most valuable legacy of the war, at least in the matter of material, is the amount and magnificent quality of the artillery with which we are now supplied—enough, as is shown elsewhere in this issue, to supply at a day's notice, an army of one million men. Next to that is the greatly enlarged facilities for the speedy production of guns, shells, powder and (unless it be interdicted by common international action) of war-gas. Congress should vote, without debate, the necessary moneys for properly housing and caring for this equipment and for maintaining the manufacturing plants in first-class condition.

The Gun is the Thing.—Only to those who have access to the official records of the war is it known what a great advance was made during the late war in the development of naval warfare. The outstanding lesson is the supreme importance of the gun—the big gun—whose accuracy has been brought to a truly marvellous pitch of accuracy. So true is this that the gun, if rightly aimed, will hit the mark unerringly. Hence the value of a good gun-pointer. Admiral Plunkett once valued his at $25,000 apiece. Today, in this era of director-firing, which tends more and more towards the substitution of a single man for many in salvo-firing, his value may soon be set down at one million dollars.

Where Are the 75-Mile Guns?—If we remember rightly, among the terms of the armistice was one demanding that the Germans hand over to the Allies the 75-mile guns with which they bombarded Paris. So far as the public records go none of these pieces has, as yet, been delivered, and we are inclined to think that they have shared the fate of the captured German flags, which, with characteristic want of good faith, were publicly burned by German officers on the Unter den Linden, Berlin. The so-called "Big Berthas," the dismantled foundations of which were found by our troops during the German debacle, are not these weapons, but were pieces of 15 or 16-inch caliber of considerably less range.

Bad Condition of Belgian Rolling Stock.—According to Robert E. Thayer, in a letter to the *Railway Age* from Brussels, master mechanics who are discouraged with the condition of equipment on railroads in the United States, need only go to Belgium to find out what bad conditions really are. "Crack trains are being hauled by locomotives which would give the boiler maker a very satisfactory shower bath if he entered the fire box." He tells us that the equipment situation in Belgium is beyond description; furthermore there are practically no means for repairing the rolling stock. The present equipment is made up of Belgium locomotives and of 1615 picked from surrendered German equipments. The balance consists of what the Germans left behind on their retreat and what France returned of the 2,000 sent to France at the time of the German invasion.

Science

Botanical Explorations Along Humboldt's Route.—A plan for coöperative investigations of the flora of northern South America was formed last year by the U. S. National Museum, the New York Botanical Garden and the Gray Herbarium of Harvard University. The first field expedition under this plan, conducted by Dr. J. N. Rose, spent the latter half of the year in the south, mainly in Ecuador, and collected upwards of 6,000 botanical specimens. A part of Dr. Rose's itinerary, down the interior Andean valley from San Antonio to Loja, was a route followed by Alexander von Humboldt, at the beginning of the nineteenth century, and many of the plants collected by Humboldt were re-collected by the recent expedition.

The Natural History of the District of Columbia is set forth in detail in a handbook by W. L. McAtee, published as a bulletin of the Biological Society of Washington. The author traces the history of biological observations in this region, beginning with reports of Captain John Smith, in 1608, on the occurrence of bears, deer and other animals. At present about 1,600 plants are known from Washington and vicinity; the insects include 3,000 species of beetles; there are 90 species of mollusks, 308 species of spider, 10 phalangids, and 246 rotifers. Fish species number 94, batrachians 27, and reptiles 36. There are 300 species and subspecies of birds, and 41 species of mammals. Altogether the District is a remarkably interesting collecting ground for naturalists, and Mr. McAtee furnishes them with many useful hints.

The Reflecting Power of Clouds.—Some interesting investigations on this subject have recently been reported by Mr. L. B. Aldrich, of the Smithsonian Astrophysical Observatory. Mr. Aldrich arranged with the Aviation Service at Arcadia, Cal., to install a pyranometer on a military balloon, which was sent up through a layer of fog or low cloud covering the San Gabriel valley. This instrument measures the heating effect of radiation received from the whole sky, or from the sun or the sky separately, as desired. An Army officer who went up in the balloon exposed the pyranometer repeatedly from 7 to 11 in the morning, upright to the sun and sky combined and inverted to the radiation coming up from the layer of cloud. The instrument was connected electrically with the ground, where the readings were recorded by Mr. Aldrich. The measurements showed, with substantial uniformity, that 78 per cent of the radiation falling on the upper surface of the cloud or fog was reflected. From this it is inferred that a planet completely enveloped in smooth clouds would be shielded, by reflection, from about 78 per cent of the solar rays. As the mean cloudiness of the earth is about 50 per cent, about 39 per cent of the solar rays would thus appear to be turned back into space and be ineffective to warm the terrestrial surface.

Proposed National Nutrition Laboratories.—Professor Graham Lusk has recently set forth the valuable and varied work that might be done by national laboratories of human nutrition, the establishment of which in France, Italy, England and the United States was recommended last year by the Inter-Allied Food Commission. At least a quarter of the income of a nation is devoted to the purchase of food by its citizens. Lack of nourishment is a fruitful cause of social disorders, as has been made amply evident by recent events in Europe. Hence it is a matter of the utmost importance to investigate thoroughly the whole subject of food supply and to apply on a national scale the information obtained. People must be cautioned against ill-balanced diets and overeating as well as aided in solving the problem of getting enough food. There is a vast field, says Prof. Lusk, in the study of the psychology of food. "The Jews are told as children that pork is unfit for food and they rarely conquer their repugnance to it. The English are told as children that maize is food for pigs and persist in their unfounded prejudice against it." The proposed laboratories should keep a complete statistical record of the available food supplies of the several countries and be in a position to advise the governments as to the best ways of making such supplies adequate in quantity and quality to the needs of the people. Would not a national nutrition laboratory be one of the best agencies in reducing the high cost of living?

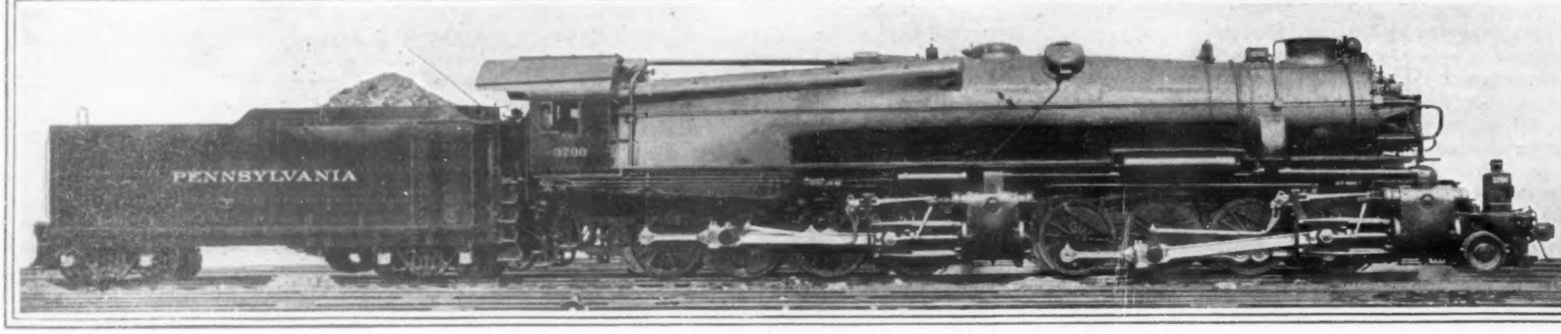
Engineering

A Concrete Flagpole was recently erected before the administration building of the Ancon Hospital in the Canal Zone. The pole is eighty feet long, ten feet of which is embedded in the ground. Concrete was used owing to the difficulty of obtaining a wooden pole of proper size. Instead of using a pre-cast pole which would have been difficult to erect and would have required heavy reinforcing to stand the strains of handling, the pole was cast in place. A light tower was built in which the forms were carried. The pole measures 17 inches in diameter at the bottom and 8½ inches at the top. The longitudinal reinforcing consists of eight square bars ranging from 1¼ inches at the bottom to ½ inch at the top of the tower and at intervals of two and three feet there are hoops of ⅜ inch steel. The pole was successfully cast and, as soon as the forms were removed it received a float-finish coat.

The World's Largest Ore Dock is located at Duluth. It is 2,438 feet long or big enough, as the *Railway Age* puts it, "to dock two of the world's largest ships, the "Bismark" and the "Leviathan" end for end on either side. In constructing this dock over a million feet of piling was driven. The space surrounding the dock was enclosed in a cofferdam constructed of steel sheet piling. Then the space was unwatered and partially filled with sand. Finally a huge concrete slab was poured in which the ends of the piles were embedded to a depth of nine inches. The superstructure of the dock has 284 ore pockets with a capacity of 6,540 cubic feet each. In other words each pocket will hold the contents of eight standard 50-ton ore cars so that the capacity of dock expressed in cars is 3,072 and in tons 153,600. Over 29,600 tons of steel were used in the construction of the dock which would require about 60,000 tons of ore, or less than half the capacity of the dock, and it would take less than half an hour to load this quantity of ore into boats. The new dock was placed in service on May 1st of this year.

Novel Method of Back-Filling a Tunnel.—The new aqueduct of Winnipeg, Manitoba, passes under the Red River in a tunnel 1,100 feet long. The tunnel is a ten by ten foot bore cut through solid limestone and within this is the 60-inch cast-iron pipe of the aqueduct. The rock is badly seamed and has many pockets. The contract called for completely filling in the space around the pipe with concrete and further stipulated that compressed air must not be used in placing the concrete. Accordingly the following method was used: Prior to placing the pipe a concrete floor was laid and carefully graded for the pipe to rest upon. After the pipe had been laid, bulkheads were erected, dividing the tunnel into sections which were successively filled to within two feet of the roof. Then concrete dams were built to the roof, sealing off the sections, and through holes previously bored from the surface through the roof the cavities in each compartment were completely filled. The compartments directly under the river were filled through pipes extending up to a temporary trestle.

Turning an Auxiliary Condenser Into an Oil Cooler.—The S. S. "Anoka" of the American Hawaiian Steamship Company, which recently arrived in New York Harbor from Portland, Ore., ran through very warm seas, the log book showing sea water temperatures of 88 degrees day after day. This condition made it very difficult to keep the lubricating oil cool, especially as the boat was equipped with only one cooler. In fact the oil entered the cooler at 124 degrees and came out but one degree lower. As a result of the use of this hot oil the bearings of her turbines grew hotter and hotter, and at last, when they reached 164 degrees, the chief engineer, Arthur Sheridan, decided that something had to be done. Casting around for a remedy, he conceived the novel idea of transforming his auxiliary condenser into an oil cooler, and this he proceeded to do with the aid of such tools and piping as he had on board. The success of this plan was complete, as the oil temperature was immediately reduced to 103 degrees and the bearings kept in proper condition. After reaching port, Chief Sheridan boiled out the condenser with soda and kerosene and was ready for port operation.



Freight locomotive of the 2-8-8-0 Mallet type recently completed and put in service

Rolling Stock of 1919

What the Current Year Brings Forth in Locomotive and Car Design

By Herbert T. Walker

THE requirements of present railroad conditions are such that both locomotives and cars have to be designed to secure the maximum hauling power and the fullest carrying capacity, combined with simplicity of design and rigid economy of material consistent with the proper margin of safety.

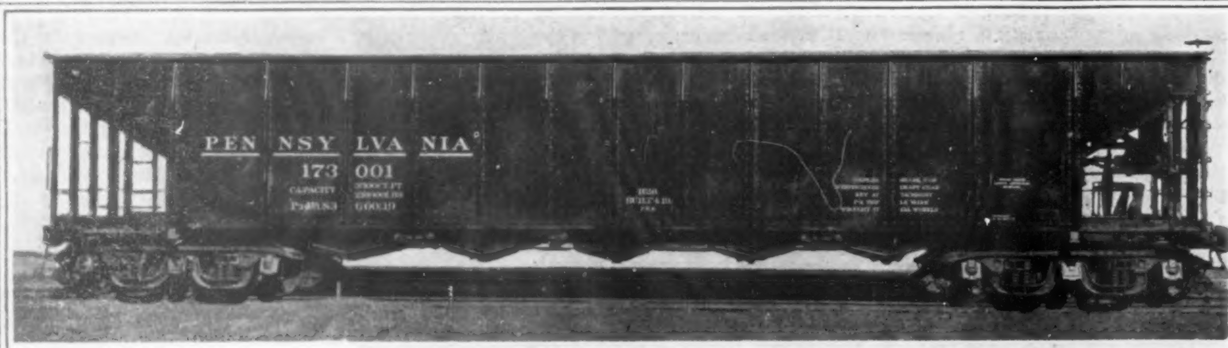
These exacting conditions have lately developed some very interesting details of construction, the working out of which has involved a high degree of scientific skill and ingenuity on the part of our mechanical engineers, and a few examples are presented in the accompanying illustrations of the latest Pennsylvania Railroad practice.

The locomotive is of the 2-8-8-0 Mallet type. It was designed by the mechanical officers of the road under the direction of James T. Wallis, general superintendent of motive power and built at the Juniata shops of the Pennsylvania Railroad.

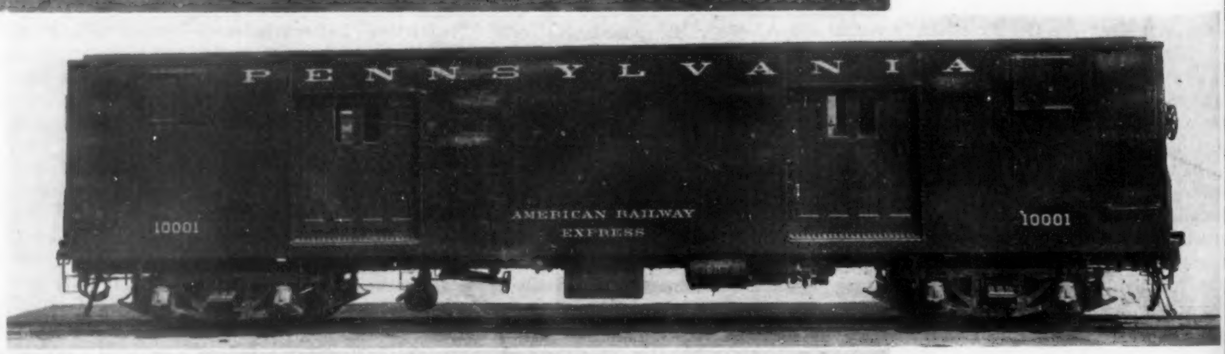
The plans for the engine were just completed at the time the United States Railroad Administration assumed control of the railroads, and one of the engines was authorized by the Administration. On account of the difficulty experienced during the war in obtaining labor and material, progress was slow, and the engine was only recently completed and put on exhibition at the Pennsylvania station, Tennessee Avenue, Atlantic City.

The locomotive is carried by eight pairs of driving wheels and a two-wheel leading truck under the front frame. This truck carries about 35,000 pounds. The driving wheels are grouped in two sets of four pairs each and are 62 inches diameter. These eight pairs of driving wheels carry approximately 540,000 pounds, giving an average of 67,500 pounds on each pair. The weight of the locomotive in working order is about 580,000 pounds, and the total weight of the engine and tender is about 800,000 pounds. It is estimated that the maximum tractive effort will be about 135,000 pounds. The total wheel base of the engine is 54 feet 8½ inches.

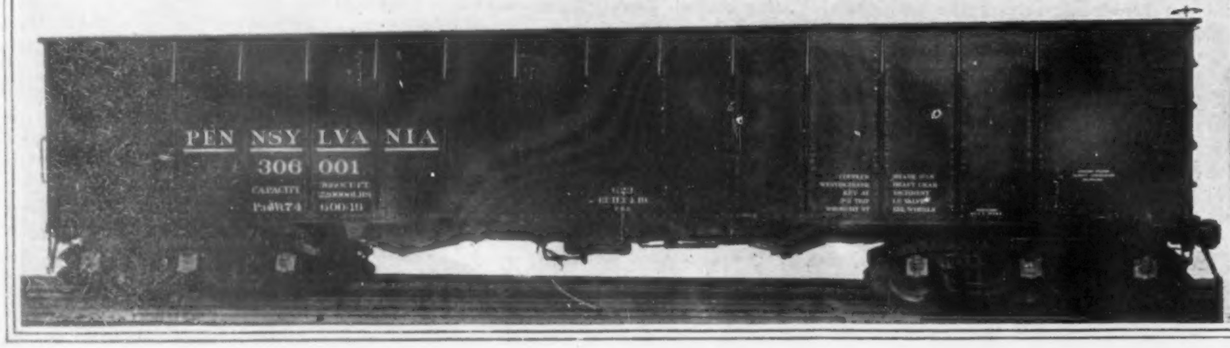
The front and rear engine frames are articulated by bolting steel castings between them, forming a jaw opening. Through these jaws passes a 6-inch iron case-hardened pin and in the jaw opening is a case-hardened ball 12 inches in diameter through which passes the pin mentioned above. On the front of the rear engine cylinder saddle is a projection containing a wrought iron case-hardened bearing for the above described ball. The arrangement will be understood by referring to the half plan and fragmentary vertical section. The rear cylinder saddle is bolted steam-tight to the barrel of the boiler, but the front engine frame has suitable castings which contact with pads with the first barrel sheet of the boiler about 14 feet ahead of the rear cylinder saddle. With powerful springs as a centering device forward of the front engine frame and ample means provided to keep the



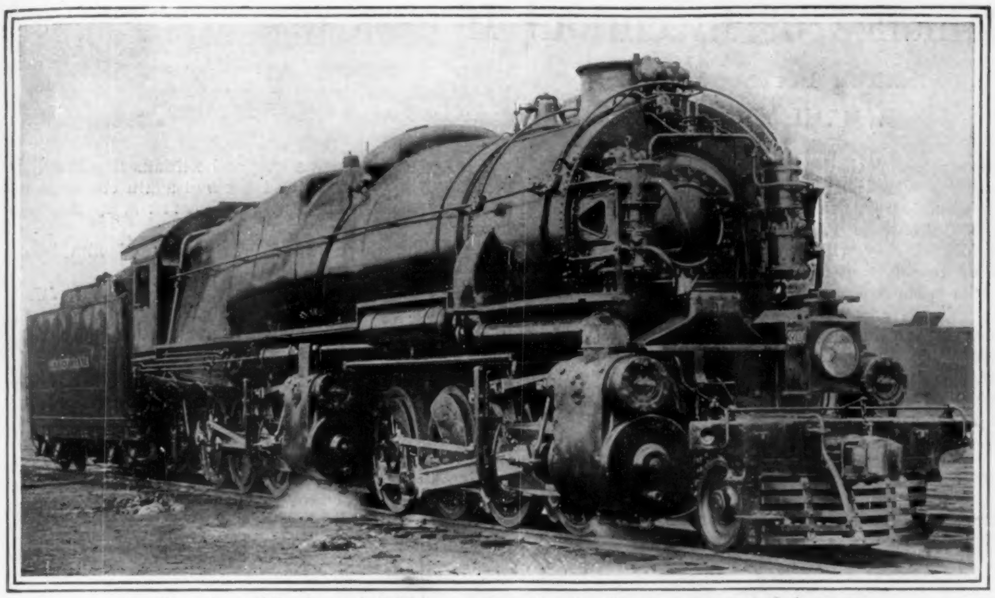
Coal car now being introduced on a leading railroad. It has a capacity of 210,000 pounds or 105 tons. It is carried on six-wheel trucks



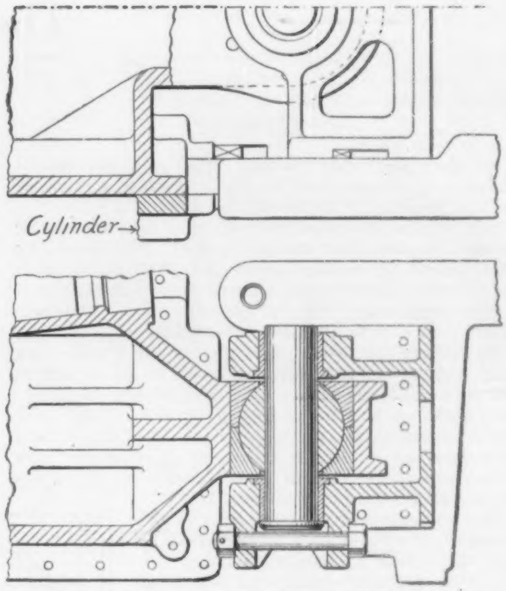
Express car designed and constructed to take care of the freight traffic handled at present in 50-ton steel box cars, and also serve as baggage car



Coal car of the gondola type with drop doors, with a capacity of 220,000 pounds or 110 tons. This is one of the largest cars of its type in existence



Another view of the huge freight locomotive, showing the arrangement of air pumps



Details of the articulated joint of the locomotive

sliding surfaces lubricated, the entire front engine can move laterally about its articulation with the rear engine when passing around curves of 400 feet radius, and this locomotive has actually been moved around a curve of 395 feet radius.

The steam and exhaust pipes, as will be seen from the illustration, are also articulated by means of ball-and-socket and slip joints.

The Walschaerts link motion is reversed by a power reversing gear of the hydro-pneumatic type. It has been found that when reversing is effected by air pressure alone, the piston has a tendency to move against the air cushion. In the present design, the introduction of an inelastic fluid acts as a mechanical lock to retain the gear positively in any desired position. Compensating levers on the valve control between the front and rear engines have a point of articulation directly above that of the engine frames, enabling the front engine to move around curves without disturbing the uniform setting of the blocks in the two sets of link motion.

The locomotive is driven by two sets of simple cylinders of 30½ inches in diameter by 32 inches stroke, thus departing from the usual practice in Mallet compound locomotive design; but a power roughly equivalent to that of compound locomotives is obtained by the use of a 50-per-cent-maximum cut-off, with a valve of unusually long stroke giving a quick release. This half-stroke cut-off has a decided advantage in point of steam consumption over a simple locomotive having a cut-off varying from 90 to 25 per cent of the stroke, in which there is excessive cylinder condensation. The working pressure of the boiler is 225 pounds per square inch, but the locomotive will be operated at only 205 pounds for the present. Even at the lower pressure, with a type E. superheater of high efficiency and the aforesaid maximum valve cut-off, a high degree of steam economy is anticipated.

The boiler is of the Belpaire type and has an abnormally large fire box and combustion chamber, the combined length of the two structures being about 23 feet. The barrel of the boiler has an average diameter of 103 inches and the equivalent heating surface of this locomotive is 11,360 square feet. The engine is fired by means of a duplex stoker and the grates are operated by a Franklin steam grate shaker.

Among the notable details of the boiler may be mentioned new devices for observing the water level. These are four in number and comprise the usual gage cocks; a water glass of the Klinger type mounted on the back boiler head; a Sentinel low-water alarm so arranged that when water falls below a predetermined level, steam is admitted into a copper pipe which by its expansion opens a steam whistle; and a float indicator, consisting of a counterbalanced float mounted on a lever attached to a shaft which actuates an indicator on the back boiler-head. Owing to the unusual length of the crown sheet of the fire box and combustion chamber, which slopes down rearwardly, provision has been made for ascertaining the water level regardless of the variations due to changes in the grade of the track; for on ascending grades the water level at the back head as registered in the ordinary gage glass may be above the top of the glass with the front end of the crown sheet dangerously near the surface of the water. To meet this objection the gage cocks, instead of being tapped into the boiler head, as is common, are connected to three pipes extending forward to the front end of the combustion chamber. A further check in the water level is obtained by connecting the float indicator at the center of oscillation of the water in the boiler; that is, at the point where the height of the water with relation to the crown sheet does not

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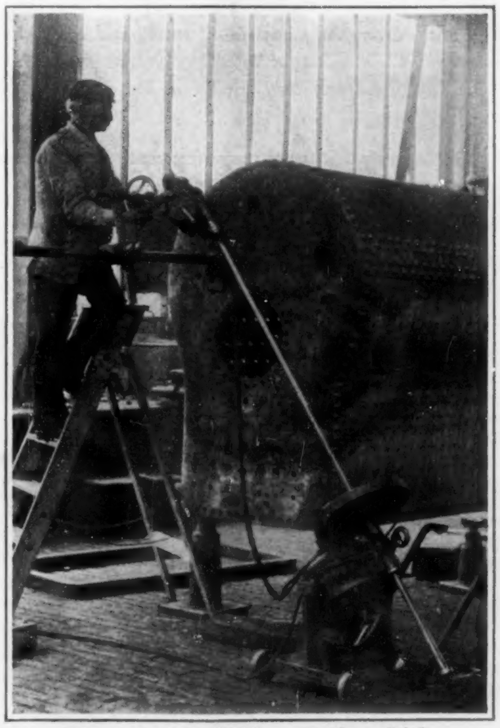
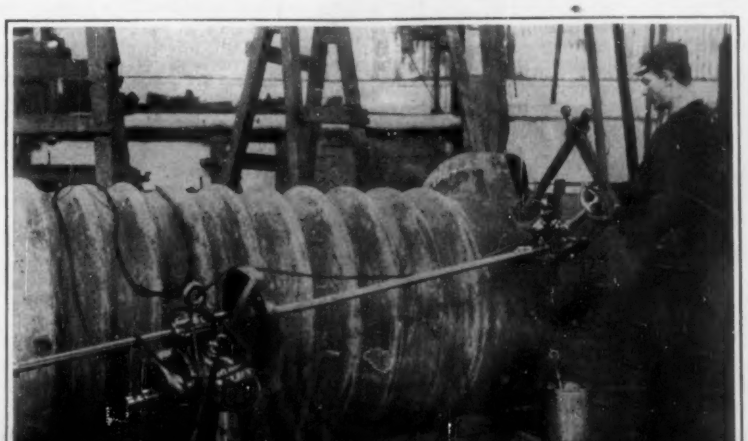


The convenient drill for an awkward job



An effective English electric drill at work

A Drill That Goes Anywhere

THE accompanying illustrations show the operation of a portable electric drill developed at Bootle, near Liverpool. It is claimed that this machine has unprecedented range, and that it can be instantly adapted with minimum adjustment to work under almost any conceivable conditions. Not alone may the motor be operated in any position on the ground, but it can be speedily detached from the carriage and slung in the air, without the use of stay-ropes, steadying gear or platforms.

It is pointed out that there are no flexible nor telescopic shafts, no knuckle joints, and no devices of any such character for transmitting the power from motor to drill. The drive is practically direct, and the important advantages of this arrangement will be appreciated fully by those who have had experience with earlier methods. It is a sound tool mechanically, with no complicated gearing likely to get out of order, and is so sturdy that it seems almost impossible for it to give trouble under any kind of reasonable treatment.

The outfit consists of electric motor, sliding shaft, and universal-movement drill-head. The motor is carried on two horizontal centers, by a frame which may be moved at will in a complete circle on the motor carriage proper. The latter is furnished with suitable handles and wheels to permit of easy movement from place to place. The motor can instantly be removed from the carriage and suspended in a stirrup or bow provided with the outfit, when working conditions are such as to require this. On the top of the motor is a bracket carrying a hollow shaft. This shaft is provided at one end with a spur wheel, driven from a pinion on the armature shaft. Through the hollow shaft slides a long driving rod, connected with the drill-head. This rod is slotted for nearly its whole length, and this slot fits a key on the inside of the hollow shaft. Thus the motor drives the hollow shaft, and by means of the key and slot the motion is transmitted to the drill-head.

The head is constructed with two pairs of bevel wheels (four wheels in all) in such manner that the drill may be turned through a complete circle in a plane at right angles to the long shaft, and through an almost complete circle in the plane of that shaft. The switch for starting and stopping is fixed direct on the drill head, thus giving instant control to the man who is drilling.—*Frank C. Perkins.*

The Romance of Invention—II

Sixteen Per Second

By C. H. Claudy

OF the many industries founded on patents, none are more obviously based upon pure invention than the many associated in the moving pictures.

We had cotton before the cotton picker and wheat before the cultivator and the reaper. We sewed by hand before the sewing machine and had illumination before the electric light. There was communication before telegraph, telephone or wireless and transportation before train, steamer or airplane.

But before the invention of the moving picture idea and, what is far different, the invention of apparatus which could present the idea graphically to large audiences, we had no moving pictures. In fact, any one who suggested that a *picture* might *move* would have been considered in the same class as one who would say the sun could "shine darkness" or an explosion would "sound a silence."

Presumably every one who goes to the "movies" has some comprehension as to how the picture appears upon the screen and why it appears to move. For it is only appearance; the pictures the eyes see are as motionless as if painted. The simulation of motion comes from the rapid and successive projection of pictures differing each from the last in some slight degree. What we see is a lot of pictures of something which appears in motion because each picture shows it in a different position from the previous picture.

It sounds simple enough. But this successive projection must attain a speed of at least sixteen separate and distinct pictures every second of time, or the eye refuses to weld the successive pictures into a whole, just as there comes a point when the ear refuses to hear vibrations as a sound, or a musical note, and distinguishes them as separate and distinct noises.

Stop and Go

If we are to see sixteen pictures every second, and each one of those pictures must appear, remain stationary, and then move on and give place for another picture, it is obvious that there must be some very rapidly working machinery somewhere. The "intermittent motion," as it is called, of a motion picture projector does some very rapid work indeed, and does it continuously and perfectly. Perhaps no other mechanism in the world must function under so difficult a set of conditions and do so accurate work at so great speed.

The successive pictures, as every one knows, are upon long strips of film, the edges of which are regularly punctured with holes, so that tiny teeth, upon rollers or sprockets, may engage this film and move it onward. This film is moved forward the width of one picture, stopped, moved forward again the same distance, again stopped, etc., sixteen times a second. The time the picture remains stationary compared to the time in which it is in motion, may be anywhere from three to five, to one. That is, it may remain stationary for five unit time-intervals, and move forward to the next position in one unit of time; but the whole ninety-six units (6 x 16) must not exceed one second in duration.

Each picture must be exactly in the same position as the one which preceded it. By "exactly" is meant just that; not nearly or almost or approximately, but exactly. It must be so accurately done that when the picture is magnified from less than a square inch to a hundred square feet (which means 120 diameters), it still appears just in the same position as the picture before it.

Finally, this process must be indefinitely repeated. During a performance lasting one hour the mechanism starts, stops, starts, stops, 57,600 times.

The genesis of the invention is somewhat clouded in obscurity by the claims of many rival inventors, each one of whom declares that his contribution to the art was what made it a success. There were toys which exhibited successive pictures through a slot through which the observer looked, in the early boyhood of many of us. Pictures so exhibited appeared to move. Edison's kinetoscope was probably the first device which showed in public a picture which appeared to move, but the kinetoscope had an audience of only one, and the pictures were but slightly larger, when viewed, than in actuality on the film.

But if the curious will go to the National Museum at Washington they will find on exhibition an ancient model of the first of the intermittent motions, and those who examine the records of the patent office will find that in 1895 C. Francis Jenkins, of Washington, patented this motion picture projector, the salient principle of which was the idea and the means that are at once the foundation and the superstructure of the present moving picture—the intermittent motion by which a moving strip of film is stopped and started, stopped and started. That little intermittent gear is the heart of every motion picture camera and every motion picture projector the world over. It was this patent (which Jenkins sold for $5,700 to Armat) that became the foundation of the Motion Picture Patents Co., which at one time was demanding royalties from all the industry and threatening to throttle it by the destruction of competition.

AS Mr. Claudy points out in this, the second of his series delineating the Romance of Invention, no one man can be regarded as the father of the motion-picture industry in the sense that Bell is the father of the telephone. But Jenkins has always been identified with moving pictures, he has at least one fundamental patent to his credit, and he exemplifies very well the connection between successful inventing and the industry of the moving film. He has accordingly been selected as the subject of the present sketch.—THE EDITOR.

The Growth of an Industry

In the twenty-five years which have passed since this curious but apparently valueless device was patented, the industry has grown to be the fifth largest in the country. It now has a vested property interest of one billion, three hundred and fifty million dollars. Last year it manufactured twenty million feet of film (negative) and from these negatives sixty-eight million feet of positive film. The yearly profits are approximately half a billion dollars. Eleven million of our people or one-tenth of our population, see motion pictures every day. Thirty thousand people engage in the industry.

Three tons of silver bullion are used every week merely to make film stock of which there are 50,000,000 feet made a month. The difference between the amount of film stock made and the amount of negative and positive film produced is accounted for both by the amount exported to the four quarters of the globe, and the fact that to take ten or even twenty times as much negative film in making a motion picture as is finally used in the finished negative is not at all uncommon. If a producer stage a train wreck, for instance, and crash two railroad trains head on, or topple half a dozen automobiles over a cliff, he will not depend upon one camera and one negative to secure it, but may have half a dozen or more instruments all clicking away at different angles. Again in making "features" or stories for the movies, the director will make each scene as long as he thinks it will stand, but the editor will cut and cut and again cut until he has compressed perhaps a five-hour-run story into one hour.

Altogether there are 120,000 miles of film made every year.

It is of passing interest to note that the city of Los Angeles houses so much of the producing industry as to be responsible for eighty-five per cent of the picture negative of the whole world.

Quite a child to grow from one little toothed wheel with a slot in it.

Mr. Jenkins has been a lot of things in his lifetime, but his principal occupation has always been invention. He was born on a farm and to be a farmer, if he followed the desires of his Quaker father. He is rather proud of having been a farmer and often refers to the fact that many farmers have become great inventors, citing the typewriter, the shoe-lasting machine, the hypodermic needle, etc., as examples. But he never wanted to stay at farming, and so went to college, where he graduated as a civil engineer. Next he tried cow punching in the Panhandle, from which he graduated to moving machinery for mining purposes in New Mexico, after which he built logging railroads in the Northwest. Later still he came to Washington and took service with the Government, but he was too restless for red-tape labor and soon set up his own shop where he could tinker to his heart's content. He was forever tinkering with something and forever trying to find, not an improved way of doing something already done, but a totally new way of doing it. Oddly enough, for the tribe of professional inventors is not a large one, Jenkins has made it pay, and of his three hundred and some patents, he succeeded in selling, in his own words "about eight out of ten."

At the time the first intermittent-motion machine was first exhibited, few realized what it might be. Even the Franklin Institute was doubtful of its economic value. Mr. Jenkins is fond of telling the story:

"Contemplating this billion dollar investment, and its more than million dollar daily income, I can but remember with amusement the remark a member of the Franklin Institute made when in 1895 I exhibited this early machine before the Institute. Some one had recommended the award of the Elliott Cresson medal, and another member, rising, said: 'I heartily second this motion, but while I am on my feet I should like to ask Mr. Jenkins if he knows of any way by which the device can be made commercially profitable?'"

Some Queer Angles of the Motion Picture

At the present writing eleven hundred and ninety-seven patents have been granted for motion picture apparatus and accessories. When the first patents began to come out they were put in the Patent Office classification of Optics. But the child outgrew the parent, and now they have a class of their own, and several sub-classes to look after the claims of inventors of projectors, new intermittent motions, continuous motions, lights, rewinders, spools, developing machines, cameras, shutters, etc., etc., etc., without end.

There are a number of curiosities connected with moving pictures which make the story of the rise of the industry in so short a time but the more fascinating. For instance, just what is a moving picture? Sounds like an easy question but to define it is less simple than appears. Try it for yourself. Then ask if your definition would apply to the projection of a stationary object photographed on moving film, or to the titles in a moving picture film.

The Society of Motion Picture Engineers (which Mr. Jenkins founded and of which he was twice president) defines it thus: "The synthesis of a series of related picture elements, usually of an object in motion."

Here is another curiosity. The better the projector is, the faster it wears out. This is not a joke, but a fact. It is obvious that the light which is projected

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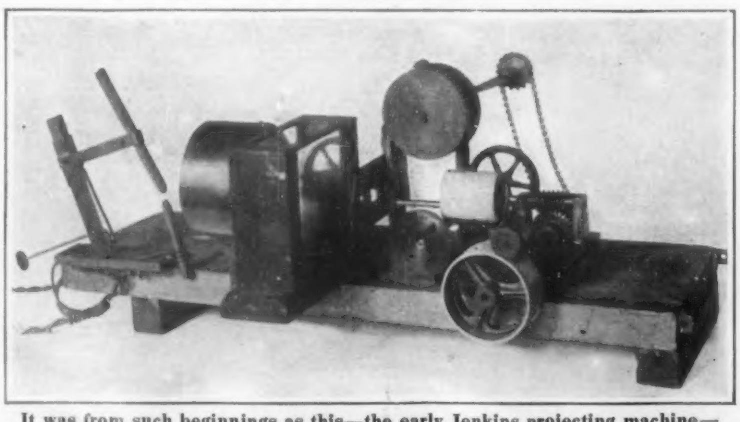


It was from such beginnings as this—the early Jenkins projecting machine—that the motion-picture industry grew

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

What Is a Cause?

To the Editor of the SCIENTIFIC AMERICAN:

I have read A. J. Lotka's article on high prices and it simply states the obvious, e. g., that if all the merchandise produced in a country during a certain period is sold for a certain amount of money the average selling price of each article can be obtained by dividing the number of units of wealth produced into the money spent for same. That is $Np = M$, or $p = M/N$, in which N equals the number of units produced, p equals the selling price of each unit and M equals the total amount of money expended for merchandise produced.

Now as you vary the values of M or N, the value of p varies accordingly. This, however, explains nothing. It is merely a statement of a fact after it has occurred, and the dollar in this case is merely used as a means to measure the variation of p and not to explain it.

For example: The speedometer measures the speed of an automobile, it does not cause it. If therefore an automobile increases its speed you do not attribute the increased speed to the speedometer. Why then attribute advancing prices to the money in circulation?

JEROME LEVY.

New York.

[*Mr. Levy's criticism is unquestionably correct, so far as it goes; but we would suggest that the formula cannot reasonably be expected to set forth a prima facie condition of cause and effect, and that Mr. Lotka did not so use it. Any mathematical formula is of value as enabling us to get a better insight into the phenomenon which it represents; we do not, however, expect it to tell us anything conclusive about causes and effects. Thus, in the gas formula which Mr. Lotka himself has employed in analogy, we have pressure times volume proportional to temperature; but no one of the three factors is identified as a causative one. If we change the pressure and hold the temperature fixed, we change the volume; does the volume change because the pressure was changed, or because the temperature was fixed, or because of the physical fact that lies behind the formula, or because of the formula itself? We might have some trouble in selecting the true cause; certainly the formula itself is not that cause; but the formula is none the less valuable.*

Another correspondent has pointed out that sometimes, instead of the prices going up because the volume of money has gone up, the reverse is the case. That is, prices go up, and a benevolent legislature considers measures to create a greater supply of currency to meet the situation. Mr. Lotka suggests that perhaps the activity which we really get is, so far as causation is concerned, a combination of the two. Just as we have the vicious circle of prices and wages, each going up because the other goes up, perhaps we have a vicious circle of prices and money-volume, each increasing because the other increases. A phenomenon in which it is difficult or impossible to isolate a single fundamental cause is not all a novelty; it is in fact rather the exception when we can point clearly and unmistakably and without ambiguity to the cause of a train of events.—THE EDITOR.]

An Extinct Bird?

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago I read an article regarding the "Whooping Crane," once numerous along the New England coast but now claimed to be extinct. Article stated that the last known specimen of these birds had been mounted and placed in a museum at Philadelphia, I believe.

Now, there is a pair of these birds nesting near this place and I am writing you of the fact thinking it might be of some interest to naturalists. Birds could be captured easily, I believe.

R. J. CRAIG.

Mio, Mich.

Steam Frigates

To the Editor of the SCIENTIFIC AMERICAN:

The article headed The "Savannah," signed by Leonard D. Compton, in a late issue of the SCIENTIFIC AMERICAN states that the old battleships "Maine" and "Texas" "carried masts, yards and canvas," and "that in a typhoon some one estimated their sailing speed at three knots an hour, which was probably excessive."

The writer states also that these ships were obviously, in the minds of responsible officials, sailing ships with auxiliary steam power plants. There could be nothing further from the facts. If the original rig designed for the "Maine" had been used this last statement might have had some foundation.

Her original design called for a full bark rig. That is, three masts, square rig on fore and main masts and fore-and-aft rig on mizzen mast. This rig was never put on her. Instead, two military masts were used, the foremast stepped well forward and main mast well aft. She had a fighting top on each mast and above that a light top-mast and spar for signalling purposes. She also had a light gaff on each mast for the same purpose. Her engines developed 9,000 horse-power. It hardly seems possible that any one could call this ship a sailing ship with auxiliary steam power plant.

I have a blue print of the old ship as she was to have been originally which I got from the Quintard Iron Works where her engines and boilers were built and where I worked at the time.

The "Texas" was designed in England. Her rig was practically the same as the "Maine's" with an extra fighting top about one-third way up each mast.

H. F. CHAMBERLAIN.

Warwick, N. Y.

The Hudson Vehicle Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial in the August 2nd issue of your publication is very timely and it is hoped that it will have some influence on the board of engineers in considering a design for this tunnel.

It is gratifying to note that you recognize the seriousness of this problem and that you can well understand that it might require for supplying fresh air and removing exhaust air a tunnel even larger than the Traffic Tunnel itself.

Having been identified with the profession of heating and ventilating for 10 years I can offer my opinion that the ventilating of this tunnel is of first importance and what is most serious is the fact that there has been no similar project in operation to give the engineers data or to act as a guide in the design of the ventilating system.

It seems almost certain that the fresh air could be supplied from the top of the tunnel and the exhaust air removed from or near the bottom of the tunnel as the fumes and gases evolved are for the most part heavier than air.

The determination of volume of air as you have pointed out can be calculated very closely and a liberal margin can be provided but it appears to me that the most thought must be given to the distribution of the air, as this ventilating system must be right the first time as it would be a tremendous failure for the entire tunnel should the ventilating system fail to perform its function and have to be re-designed with enormous cost.

With the traffic that it is anticipated this tunnel will handle and moving at a comparatively slow rate of speed an occupant will be in this tunnel for a considerable length of time and unless the carbon monoxide fumes and other poisonous gases are properly diluted and quickly removed the tunnel will not have the patronage it deserves.

I believe that the final success or failure of this tunnel will entirely depend upon the excellency of the ventilating system.

F. R. ELLIS.

Boston, Mass.

An Electric Welding Job

To the Editor of the SCIENTIFIC AMERICAN:

Your August number of the 9th contained a very interesting account of a difficult piece of engineering work in my line. Repairing the stern frame of the "Northern Pacific" being as it states the largest marine weld ever made.

I appreciate the size of this job and the big saving in time and money that was made possible by the thermit process, and to show how much can be done and how difficult jobs can be successfully undertaken by the welding process, I will state here another case, probably the only one of its kind of that size that has been done in this country.

About six months ago I electrically welded a crank shaft on a quadruple steam engine of 4,000 horse-power, single screw, of a boat running between Seattle and Tacoma, it being the fastest boat operating on Puget Sound. This shaft was broken in the web clear off, with two cranks back of the weld. The shaft was welded in place, without being removed out of the journals and kept absolutely in line all the time during the welding process. By careful handling and taking care of expansion and contraction, this shaft when the work was completed was absolutely straight.

The size of the shaft is 8¾ × 14¾ square web.

This much is possible with the electric arc welding when handled by experienced men and we consider it of interest and thought perhaps you would like to know about its accomplishment.

P. J. SWANSON.

Seattle, Wash.

The Wireless Incendiary in Practice

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 14th, you present an illustration of an apparently elaborate apparatus by means of which combustion has been started at a distance by an electric wave. The possibility of a new danger from wireless waves is suggested. The most important part of this article lies in its reference to fires among cotton bales. It shows that so simple a thing as a broken metal strap may be as effective as the elaborate apparatus illustrated. It ought to bring up for consideration the wide but obscure possibilities of combustion under ordinary conditions of household and industrial operation.

These possibilities have been greatly increased by the multiplication of electric developments, and, strangely, have been obscured by the almost universal substitution of the electric light for gas. Sixty or seventy years ago, when gas was driving out whale oil and kerosene, and when New York City houses were being heated by crude hot air furnaces, certain electric phenomena were common things to children which have now become almost forgotten. These were connected with the production of electric sparks by friction. Such sparks sometimes occurred without a purposed cause, but as curiosities were often purposely produced. The best conditions for experiment were a cold day with clear dry air, a house highly heated by a hot air furnace, and a floor covered with a velvet carpet.

Under these circumstances two operators were needed—one to stand near a gas bracket in the side wall, to turn on the gas at the critical moment, and one to shuffle over the velvet carpet with loose, smooth slippers, and to put his finger tip exactly on the slot of the gas burner nipple. If these things were carefully done a spark would pass from finger to nipple, and the gas would burst into flame.

The chief value of these results and of the "igniting resonator" illustrated as a scientific invention, should lie in their suggestiveness as to the increasing production of electric currents and as to the ordinary conditions which may produce "igniting resonators" at unlooked for times. Nothing would seem more harmless than an ordinary leather belt running over a pulley, the danger of being caught in it being the only apparent one, and that being specially guarded against in these latter days by the enforcement of laws as to protection. Nevertheless, every such belt may produce currents of electricity. In the work room of a factory the existence of these currents is likely to be unnoticed. They are unfelt, unless some one passes under a big belt near enough to have his hair attracted; or unless some "sensitive" experiences a sense of discomfort in the neighborhood of the running belt. The current is invisible except on rare occasions or under unusual conditions, but such conditions can readily be produced. In a factory where every effort had been made to lessen the risks from fire, the danger producing conditions were set up in the most innocent way. A steam pipe (probably about 2 inches in diameter) was cased in to prevent condensation. Sheets of rolled steel roofing were wrapped round the pipe, were kept in tubular shape by wire bands, and were stuffed with mineral wool. The pipe was thus covered with a succession of short tubes (possibly about 20 to 24 inches long) the ends of the tubes only meeting approximately. In the middle of the room was a hydraulic pump, driven by a wide leather belt. The electric current generated by this belt went over to the insulating tube, travelled along it, and at one spot leaped the slight gap between two tubes, causing a vivid spark at each leap. Had there been an escape of gas at this point the gas would at once have been lighted; and if a collection of ordinary fluff had resulted, from dusting or sweeping, such fluff would certainly have ignited.

To sum up the matter, "igniting resonators" can be produced in the simplest and most unlooked for ways, and the electric currents, ever easy of production and ever increasing, may be the cause of many disastrous fires. The broken metal band around the cotton bale is a notable instance, and a single spark might easily cause the explosion of dust in a flour mill.

THOMAS DUNKIN PARET.

Sarasota, Fla.

New Worlds to Conquer

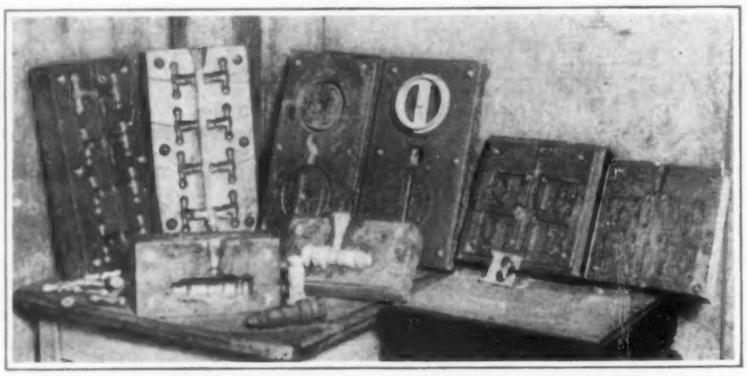
Asbestos, Ground and Mixed with a Binder, Likely to Score a Big Success as a Refractory and Insulator

MOST of the asbestos in the market of recent years has been a fibrous variety of the mineral serpentine, to which the name chrysotile has been attached as a commercial designation. This occurs in narrow veins, yielding short fibers hardly exceeding three inches; these are however of extreme tensile strength, usually of a delicate silky luster, very flexible and elastic, and of yellowish or greenish color.

It will doubtless surprise many who have thought of the word asbestos as standing for a definite mineral with a definite composition to know that this serpentine is quite different from the substance first known as asbestos. The material formerly used in the arts under this name was in fact a fibrous form of hornblende or amphibole, mineralogically quite distinct from serpentine, though possessing the same fire-resistant qualities. Amphibole asbestos is usually gray or white; and while it is commonly harsh and brittle, it possesses the distinct advantage of long fiber, not seldom attaining a length measurable in feet, and occasionally a single fiber being found of two yards or more.

The Canadian asbestos which constitutes the bulk of the world's supply at the present moment is serpentine; while that of the United States, of no great commercial importance hitherto, is mainly of the same sort. The deposits of Corsica and Italy, on the other hand, were mostly amphibole; in fact, the Italian production is still considerable. In view of the dominant position heretofore occupied by the chrysotile, it is of interest to note a current tendency toward the revival of amphibole asbestos, especially in the direction of the employment of the substance in wholly novel ways. The amphibole fibers to which this applies are magnesium-calcium silicates with a small percentage of ferrous and aluminous oxides. They are ranked among the very highest thermo-electric resistants; and if even a part of the wide range of utilities promised by new methods reaches general industrial adoption, amphibole will be established on a plane which asbestos has never before approached.

The first source of raw amphibole sufficiently pure to be used in these developments without a preliminary calcining was found in Cullowhee Township, Jackson County, North Carolina, late in 1918. In the middle of the present summer it was discovered that a hill at Tompkinsville, Staten Island, within the city limits of New York, long known as a freak serpentine intrusion bearing asbestos of good fiber, was heavily veined with amphibole asbestos of the actinolite and tremolite varieties. Engineering reports are quoted as showing several million tons, in perpendicular veins running completely through a 150-foot elevation at a distance of only 600 feet from tidewater.



Permanent molds of amphibole asbestos, of varying complexity, which have been used for from 450 to 1,700 castings

It appears that new uses for this material are being found almost daily. Processes of preparation are widely varied. The first stage is the reduction of the rock by crushing to lumps and splinters; then it is reduced to powder in a pebble drum, down to a 40-mesh size for some applications, or even as high as 100-mesh for others. After this the material is mixed with binders of one sort or another, for recrystallization under the action of air-drying, low heating, acid dips, or even temperatures as high as 3,200 degrees Fahrenheit.

At the present moment the most prominent application of the amphibole is as molded insulation. Thousands of forms are made in pressure molds, rendered moisture proof, and then glazed. The material thus treated machines easily, does not warp under heat, and is impervious to all acids save hydrofluoric, which of course is not a serious exception. It maintains its positive non-conductivity at very high temperatures. For insulatory purposes a paint is also made with water solvent; this substance air-dries rapidly to a refractory and non-conductive state.

Another suggestion for the use of asbestos is in connection with processes where refractory materials are required. In this application the asbestos is of interest mainly because of the low cost and the extreme hardness of the prepared material. This does not mean that it is a second-rate refractory by any means, for one pottery kiln test to 4,800 degrees is reported. But it is in cheapness and hardness that asbestos excels its competitors in the refractory field, rather than in the heat resistant qualities possessed by it in common with other substances.

The first experiments with the amphibole in the current search for new worlds to conquer were made in the field of the permanent mold. It is plain enough that the destruction of the mold with every cast taken from it is an expensive business, and one which should not be allowed to go on any longer than can be avoided. The process of preparation of asbestos for this use is to place first the material with a double binder in a molding form, to take the impression of a metal master-form in cope and drag, and then to kiln to 800 degrees, slowly removing the moisture and establishing the first binder. The pattern is then removed, as with this preliminary binding the mold will stand alone; and the mold is

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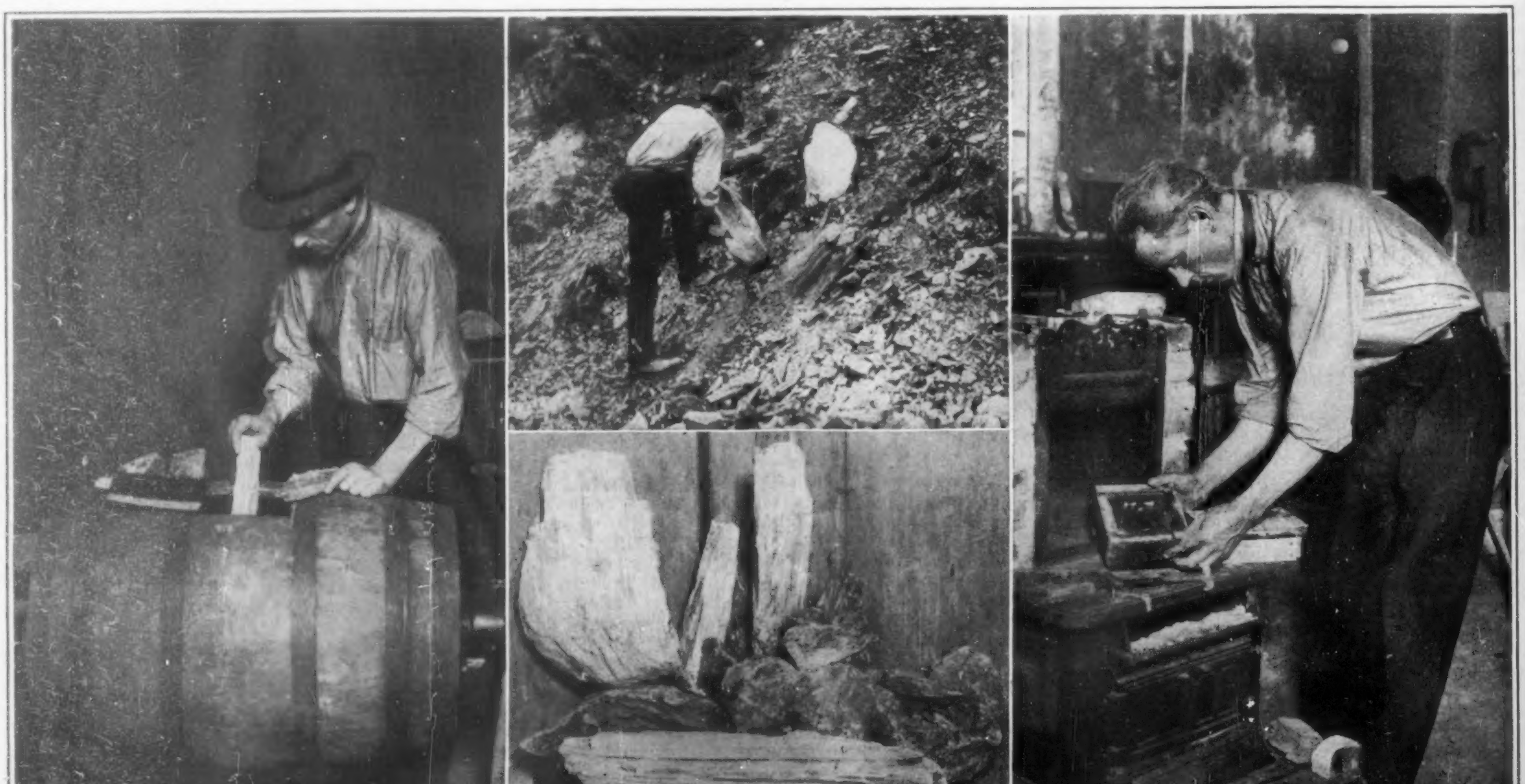
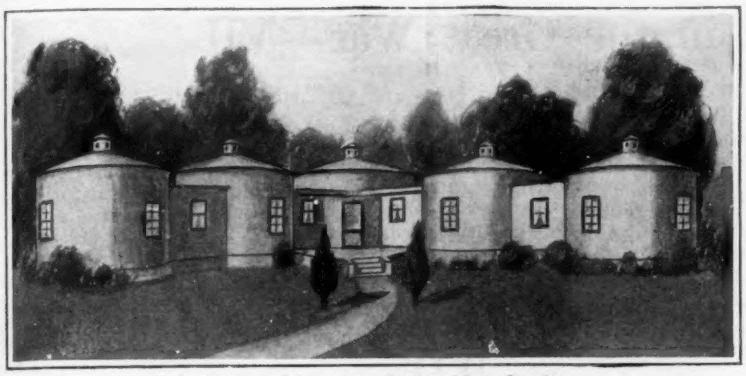
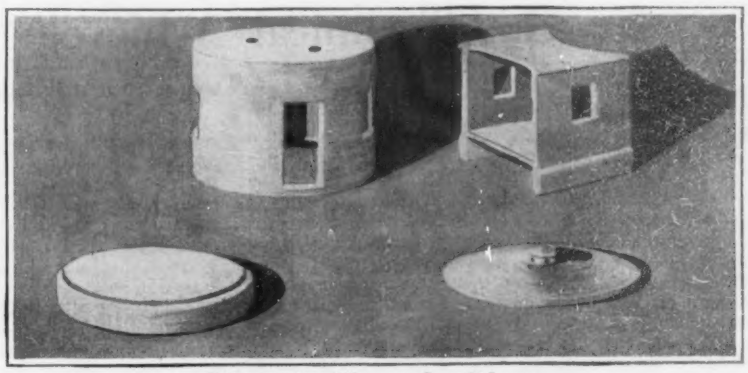


Left: Reducing asbestos to a powder by rolling it in a drum with irregular bits of granite and steel. *At the right:* A permanent mold of ground asbestos in process of making; the pattern is about to be removed after the first setting and before the final process of heat-treatment. *Center:* Quarrying amphibole asbestos from an open vein, and sample fragments of the raw product



An L-shaped house made up of round units



Components of the round -unit house

Some Ingenious Solutions of the High-Cost-of-Building Problem

ONE of the very obvious results of the war is a serious shortage in houses. In the United States alone this shortage probably amounts to one million homes as a result of three or four years of little or no building operations. In France and Belgium, where stoppage of building has been combined with the extensive destruction of villages and cities by the late belligerents, the shortage of homes runs even higher in proportion to the population. At any rate, from one end of the civilized world to the other there is the greatest shortage of housing ever experienced in modern times.

With the war at an end and the huge armies demobilized, the housing shortage is by no means solved. The high cost of labor and materials serves to maintain a relative state of idleness in the building industry; and no relief is in sight—at least not while present methods of building construction persist. And so it has come to pass that immediate relief can be afforded only by new and cheaper methods and materials which the architect and the inventor may work out together.

Eliminating the Non-Essentials

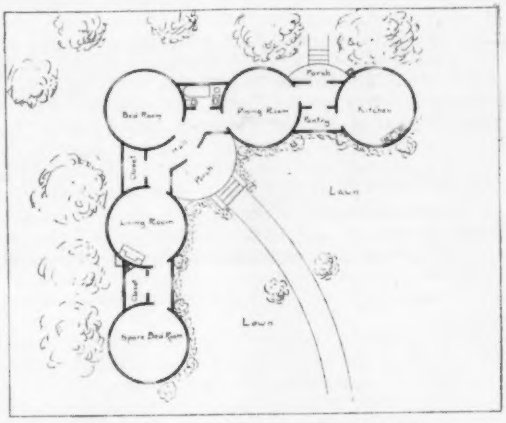
One of the large manufacturing organizations of the United States has recently started work on a colony of homes for its employees. The new houses will be located on a plot of 109 acres, which will eventually be entirely built up, affording homes for about six hundred families. The houses, which are modern in construction, will be of brick with hollow tile backing, and provided with concrete cellars and cement porches. They will consist mainly of five, six, and seven-room houses designed to meet the needs and the pocketbook of the man in moderate circumstances.

The novel feature of these houses, however, is that an effort has been made to do away with elements that have outlived their usefulness. The antiquated parlor is missing and the center hall has been replaced with a modern living room which is more economical of space. However, the plans are subject to change, as the dwellings are designed to meet the approval of the future occupants, whether owners or tenants.

Homes that Come in Pieces

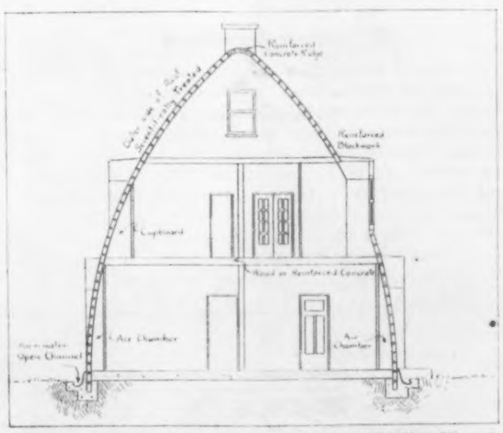
From New Orleans, La., comes a really ingenious idea for simplifying building construction. C. N. Wisner, of that city, is the inventor of a remarkable system of housing which is the subject of the upper illustrations on this page. His system consists of a series of round, unit rooms connected by hall units and finished off with porch units. These units, made of concrete, are said to be fire-proof, weather-proof, warm in winter and cool in summer. With proper care the units should last more than one hundred years.

Now the unique feature of Mr. Wisner's invention is that the units can be molded in quantities and readily transported to the site of the proposed house. A family can start with a home consisting of two or three units, connected by hall units and finished off with a porch member. Any time in the future the family can increase the size of the home by adding units in any desirable manner. The home may be laid out in the form of an L or T or even a square with an enclosed court, since the units are flexible in so far as their arrangement is concerned. The hall units are provided with closets, so that the more halls are used the greater the closest space available in the expanding home.



Plan of the L-shaped round-unit house

Equalling interesting, no doubt, is the construction proposed by Albert C. Freeman, an English inventor and writer on housing subjects. Mr. Freeman, while casting about for a solution of the building problem, came across a description of the Catenarian arch adopted by Jacques Germain Soriffiot for the middle dome supporting the lantern of the Church of Saint Geneviève at Paris. In this case brickwork was employed. After studying the construction of the dome Mr. Freeman came to the conclusion that a similar form of construction might lend itself to regular building operations, particularly for cottages and small residences in rural districts.

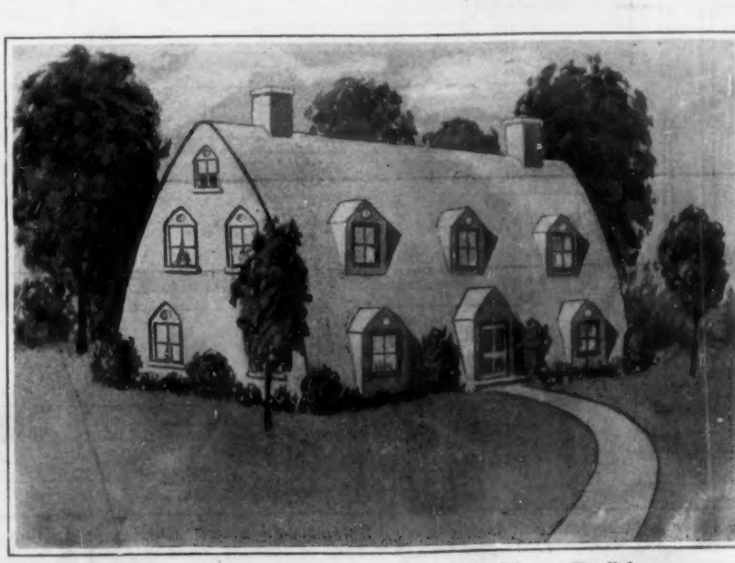


Sectional view of the house that is practically all roof

A House That Is Mostly Roof and Little Wall

The principal difficulty faced by Mr. Freeman was to cloak the arch springing from the ground. This he has done by introducing buttresses at either side. They add to the architectural treatment, and, further, strengthen the building. The construction in general takes the form of hollow walls at the ends of the building; and all side walls, which are practically the roof, have air chambers, thus making a building that is warmer in winter and cooler in summer than the usual run of houses. The air chambers also add to the strength. A new method of casting the concrete blocks, used in this form of construction, has been invented, and a patent has been secured on a machine that makes bricks of various sizes, thus calling for the use of but one machine for a job. The bricks are reinforced with metal; in fact, the blocks have a hollow cavity 2½ inches deep all round, and they are bedded together with sheets or strips of expanded metal and bedded and grouted with cement, into the grooves of the respective blocks. They are strong and rigid, due to the perfect distribution of the reinforcing metal.

Buildings erected on this construction are said to be of a perfectly dry character from the date of their completion. The cost of a dwelling of this kind is about 30 per cent less than a brick structure. No timber is employed in the roof, and no covering of slates or tiles is required. Another important detail is the dispensing with the need of rain-water gutters and leaders.



Novel reinforced concrete-block house invented by an Englishman

Soapstone

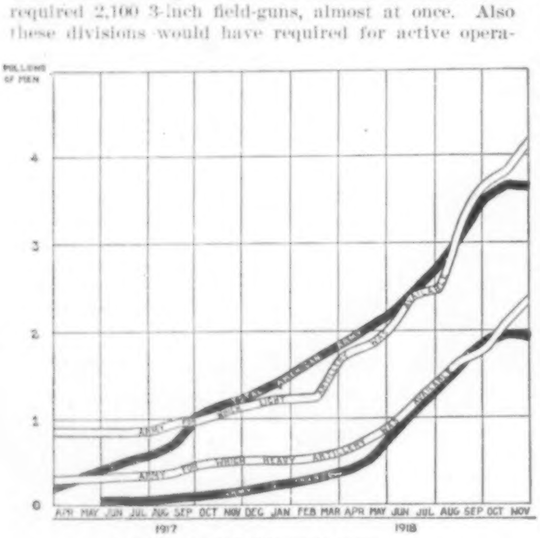
THIS is a term that has been loosely applied to several varieties of rock with differing chemical and physical properties. Some soapstones are hard, being only slightly altered from serpentine, and others are soft and contain more talc. Some varieties have a definite grain and others are composed of interlocking prismatic crystals. The difference in properties affects the suitability of various soapstones for different uses. In the construction of fabricated forms, hardness, toughness, and absence of grain are most important, but in the manufacture of foot warmers, griddles, and heating stoves for fireless cookers, resistance to heat and retention of heat are more important. Thus soapstone from certain localities in Virginia is more valuable for fabricating than for heat retention, and certain Vermont soapstones are superior for heating uses.

The market for soapstone in fabricated form, that is, in sinks, laundry tubs, trays, table tops, etc., is dependent largely upon new building construction. During the war and the attendant depression in the erection of buildings for dwellings or commercial use, the normal market for soapstone largely disappeared, but Government orders partly compensated for this loss.

Our Technical Achievements in the Great War—VII

Two Thousand Guns On the Firing Line

WHEN we entered the war, we had on hand 900 pieces of artillery, of which 544 were 3-inch field-pieces. Since one division of troops requires 50 3-inch guns, we had on hand sufficient to equip 11 divisions. When we found ourselves actually at war, it was realized that we needed an army many times larger than we then possessed. Our initial plans called for an army of 42 divisions, which would have required 2,100 3-inch field-guns, almost at once. Also these divisions would have required for active opera-



Artillery available each month

tion in France a repair shop reserve, a replacement reserve, and an unbroken stream of guns in transit. All of this would have increased the initial requirements to about 3,200 3-inch field-guns.

To keep this army going, once it was equipped, would require only 100 guns a month; but to get it going within a reasonable time would require 300 to 400 guns a month. There is a great difference between the manufacturing output necessary *to get an army going quickly* and that required *to keep it going* after it has been equipped. This explains the enormous industrial handicap suffered by a nation which enters a war without the necessary stocks of military supplies on hand for initial equipment.

"To meet the situation," says Colonel Ayres, "the decision was made in June, 1917, to allot our own guns to training purposes and to equip our forces in France with artillery conforming to the French and British standard calibers. The arrangement was that we should purchase from the French and British the artillery needed for our first divisions and ship to them in return equivalent amounts of steel, copper and other raw materials, so that they could either manufacture guns for us in their own factories or give us guns out of their stocks, and proceed to replace them by new ones made from our materials."

It was further provided that when our own army was equipped with artillery, we should at once prepare to build artillery of these same calibers for the equipment of our later divisions. This program was carried through pretty much as laid down. The French and British guns came through on time, though our own plants were slower than had been hoped or planned for in producing complete units.

In our factories our 3-inch guns were changed to take French shells and became known as 75 mm. guns, model 1916. The British 18-pounders were redesigned and became known as the 75 mm., model 1917.

In the case of the heavy guns of larger caliber the same procedure was followed. It was necessary, of course, in all this work not to interfere with American work for the Allies. The record of actual production on United States Army orders only, in spite of the above handicaps was 1,642 complete army units of artillery before the armistice was signed. The total production is shown in the accompanying diagram, in which work done for our Navy and the Allies is not included.

It should be noted that the totals for the months after the armistice are as large as those before October, although the work done in those months was very much less. This is due to the fact that certain components necessary to a complete gun were not completed until after the armistice, when hundreds of guns upon which practically all the work was done were completed. Up to the end of April, 1919, over 3,000 guns were completed in American plants, an amount equal to those purchased from the French and British up to the armistice.

Artillery Ammunition

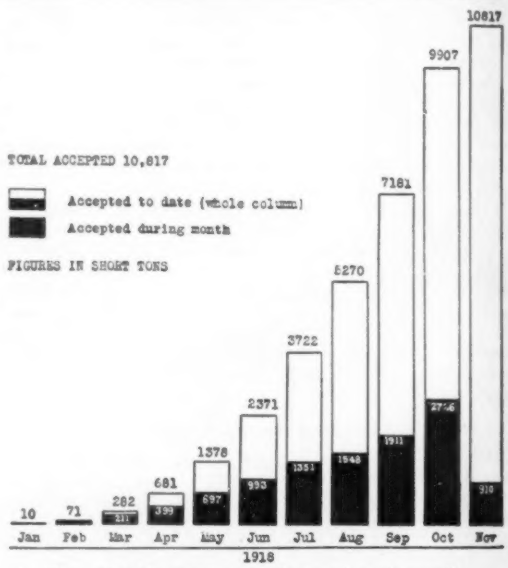
In respect of magnitude of quantities the Artillery ammunition program was the biggest of all. A large supply of American shells was produced before the armistice and shipment to Europe in quantity had begun. The ammunition actually used at the front was nearly all of French make. The diagram shows that our monthly output rose from 2,000,000 rounds in August to over 3,000,000 in October. By the end of 1918 the rounds of ammunition produced in American plants was over 20,000,000 as compared with 9,000,000 rounds secured from the French and British.

British and American Artillery Output

The accompanying diagram showing what we did in the production of artillery during the first 20 months after our entry into the war as compared with the British output in the first 20 months after her entry into the war is an indication of our effort; though it must be remembered that we had the advantage of the experience and the pioneer work done by our Allies, the white bar shows the British and the black bar the American output. The comparison shows that the British exceeded in the production of light artillery and that we did better in heavy artillery and in both sorts of shell production.

Smokeless Powder and High Explosives

Perhaps the most striking contribution of the United States to the common cause was the enormous quantity of smokeless powder high explosives produced. From



Tons of toxic gases manufactured each month

April 1, 1917, to November 11, 1918, we produced 632,000,000 pounds of smokeless powder, which was almost exactly equal to the combined output of France and Great Britain.

Our production of high explosives—T.N.T. ammonium nitrate, picric acid and others, was not estab-

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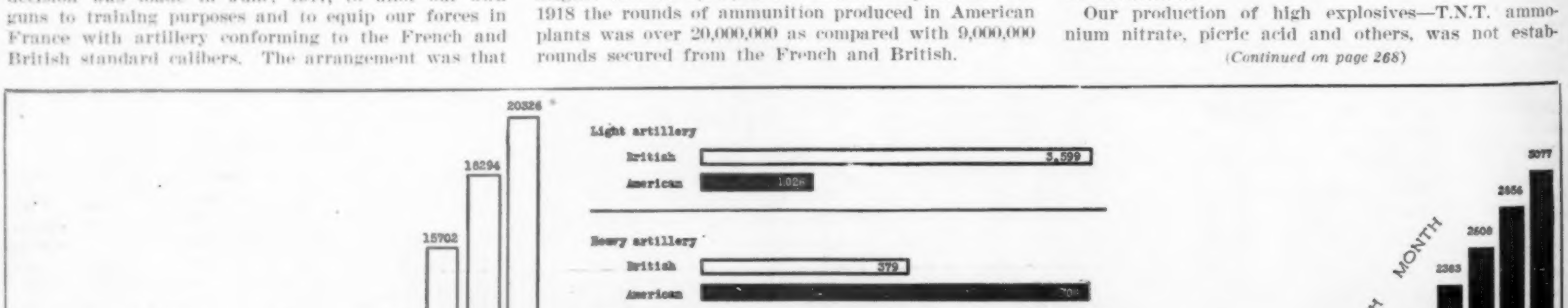

At the left: **Thousands of complete rounds of American artillery ammunition produced.** *Center:* **British and American production of artillery and ammunition in the first 20 months of war.** *At the right:* **Complete units of artillery made in America**

Salvage by Floating Towers of Concrete

A New Type of Wreck-Raising Vessel Under Construction for the British Admirality

By F. Rowlinson

WITH the sinking of millions of tons of Allied mercantile craft during the German submarine "blockade," salvage operations took upon themselves an increased importance. The salvage of wrecked vessels has always been an undertaking demanding initiative and originality in a marked degree, and the latest developments do not seem to have departed from the old traditions of daring and breadth of vision.

Although previous to the war the annual loss of cargo and ships sunk round the coasts of Great Britain amounted to $45,000,000, much of this was irrecoverably lost. But, with the scarcity of shipping and the vast number of ships sunk in the comparatively shallow waters of the "Continental Shelf" the proportion of such sunken vessels which could be profitably raised was much increased. In many cases the torpedoing has left but a single hole to be patched, and ships in this condition can, if they lie in less than twenty fathoms of water, be raised at small expense by patching the hole with water-setting cement and sheet-steel.

The greater number of these sunken ships lie outside the 20-fathom line, however, and the British Admiralty resolved to tackle the problem resolutely. The outcome of the ingenuity of their engineers has been the so-called "mystery ships" of Southwick, Brighton, on the south coast of England.

At this place, not far from the great seaside resort of Londoners, but itself a little-known village with no special claims to fame, the residents in the later days of the war were astonished to see vast quantities of materials and numbers of men appear. Work commenced and progressed with haste—the British Government was preparing, even during the war, to deal with the after-war problems of thousands of sunken wrecks surrounding the coasts. The secret was well kept. Even those few who were aware that something was afoot were ignorant of the true solution of the mystery. On the flattish sandy beach a structure took form, its appearance almost like a quay or jetty. Concrete walls rose up and took the shape of an elongated hexagon, with walls about sixteen feet high.

The structure looked very firm and immovable on its sandy bed although the fifteen-foot tide rose to within four feet of its upper surface. Conjecture took various forms. Some of the curious maintained that the mysterious operations were to result in a second cross-channel train ferry; others stoutly maintained that a gigantic pontoon was under construction to transport heavy guns and tanks to France. These conjectures were promptly upset, however, when the structure assumed a second story, less in size than the first, but similar in shape and of the same height. About the same time a second of the mysterious structures was commenced.

Building continued until each structure resembled a huge hexagonal wedding cake, with serrated edges; when four stories had approached completion, the veil of secrecy was lifted somewhat, and the purpose of the tower-like edifices leaked out. They were destined to aid in the salvage of the many ships sunk around the British Coast. The principal dimensions of the "mystery ships" as they were dubbed, are as follows:

Total length overall, 180 feet;
Total height above sea level, 125 feet;
Draught when floating free, about 12 feet;
Height of stepped portion above sea level, 60 feet.

The building was carried out as follows: Owing to shortage of steel for constructional purposes, it was resolved to use concrete, steel-strengthened, as the base material. "Units," consisting of hollow concrete boxes four feet square and two feet deep, were cast on land, and were assembled on the flat sandy beach. The units are tied together by a system of steel ties, embedded in concrete. This cellular system of construction resulted in a very rigid, very strong, but very light structure, entirely hollow internally, with walls divided into cells each isolated from its neighbors. In this manner the first story was raised, the tides washing it daily as it lay on the beach. Sluice gates having been left in the lowest story to admit water to the hollow interior as the tide rises, the structure does not float. When all the storied portion is complete, a cylindrical, hollow tower, like a gigantic conning tower, 65 feet high and 30 feet in diameter is to surmount the whole. Round this a staging 19 feet wide will run, supported by twelve columns.

ALL sorts of schemes have been put forward, by people who ought to know what they are talking about and by those who very plainly do not, for the raising of torpedoed vessels. No suggestion, however, whether practicable or visionary, is more bizarre in nature than the design of the floating towers of concrete, looking like huge wedding cakes, with which the British Navy will experiment, and which are illustrated and described herewith.

The launch of these "mystery ships" will present no difficulty, as they have been so proportioned as to float clear in 15 feet of water. When all is ready, the sluice gates are to be closed, any water remaining in the structures will be pumped out, and the first high tide (which in the English Channel at this spot reaches 15 feet or more) will float the whole clear. Thus the peculiar method of construction has obviated all necessity of providing expensive launching apparatus such as slipways, and has enabled the ship to be built almost on dry land.

The way these contrivances will be used will vary according to the position and depth of the sunken wreck. Should the vessel be upright in comparatively shallow or shelving water (so that divers may work at the bottom without danger) matters will be very simple. The "mystery ships" are to be towed to the site of the wreck and then floated over it, so that one of them lies above the ship on each side. From each of the tower-like structures steel hawsers will be passed by divers under the wreck, or if this be not possible, be attached regularly throughout the whole length, so that the salvage ships are firmly lashed to it. At low tide all the slack in the steel ropes will be taken up by winches, and with the rising tide the whole flotilla, salvage ships, wreck and all, will be lifted by the buoyancy of the former. The height of lift is limited by the height of the tide. The salvage ships, with wreck now suspended between them, but still under water, will be towed into shallower water, until the wreck again grounds. This operation is ticklish and must be accomplished gently or the already damaged vessel may be broken up completely by the shock. When the tide subsides the slack hawsers will again be lightened, and the whole process repeated as many times as may be necessary to lift the wreck into such a position as will admit of a temporary repair or patching.

Where, owing to insufficient amplitude of tide, to the absence of a gently shelving sea bottom, or to undue exposure, this method of working would be impracticable, the necessary lift is to be obtained from the "mystery ships" themselves. By admitting water through the sluice gates in the lower story, the salvage towers may be made to sink to any required degree. The ropes will then be adjusted and the water pumped out again by the powerful centrifugal pumps which are an indispensable part of any salvage equipment. It is not proposed to furnish the "mystery ships" themselves with these pumps; they will be carried alongside by smaller salvage vessels of the usual type. As the water is pumped out and the whole rises, the weight of the sunken vessel will cause the two salvage vessels to cant over towards each other, notwithstanding the breadth of their bases. To counteract this, water will be admitted to some of the cellular chambers in the walls opposite to the wreck, preserving the balance of the whole on a level keel. When the sunken vessel has been raised sufficiently the whole flotilla may be towed away to the repair docks, the suspended wreck riding comfortably in the cradle of ropes between the two towers.

The methods described are scarcely suitable for use with vessels lying in more than 20 fathoms of water. Since it is for these deeper wrecks that the contrivance has been designed, and as divers find it difficult to work for even short periods in depths greater than this, yet a third method has been worked out.

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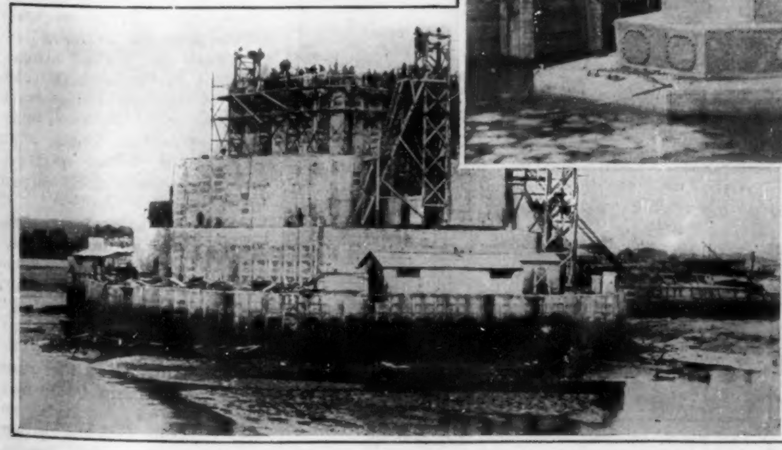
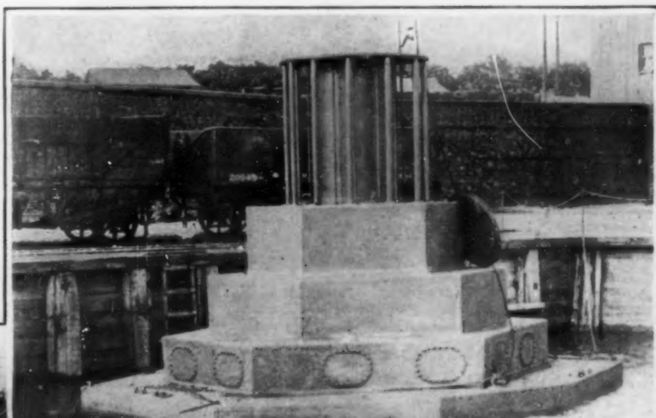
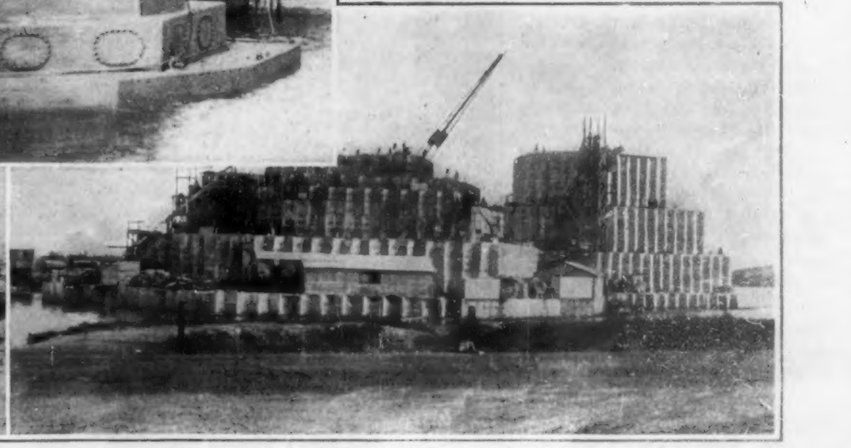






At the left: **The new salvage ships.** *At the right:* **Two of the salvage ships being constructed** *Center:* **A complete model of the mystery ships.**

Views of the new type of salvage ships built of hollow concrete blocks for the British Admiralty

The Science of Tennis

A Game Which is Designated by an Expert as Applied Physics and Geometry

By William T. Tilden, 2nd; Runner Up in 1918 and 1919 National Tennis Championships

OLD Omar Khayyam told us about a "Sorry Scheme of Things Entire." There are very few people who would believe that Omar knew much about modern times, but he surely knew how to phrase an apt verse that can be applied to tennis as it is played today.

Every player must have his "Scheme of Things," that is tennis things, entire. If there is a gap in his knowledge of the fundamentals of the game, there is a corresponding gap in the actual technique of his racquet work or court-generalship.

Tennis is applied physics, under the heads of foot work and weight placement, and applied geometry under the head of strokes and their relations to angles, spin and twist of the ball.

All students have agreed that the foremost fundamental of the game is that good old formula, on which golf, baseball, football and nearly every other form of athletics are based; *keep your eye on the ball.* This is so obvious a fact that further discussion of it in this article is unnecessary.

Tennis strokes are closely allied to two principles of geometry. First, a straight line is the shortest distance between two points; second, a tangent to a circle touches the circumference at only one point.

To hit a tennis ball along a straight line to any given point in the court, the body must be placed so that the shoulders are parallel to the line of flight of the ball, the feet perpendicular to the side line of the court, and therefore parallel to the net. The racquet must be held so that, at the moment of hitting the ball, the head is on a line with the hand and arm, and the face of the racquet is tilted slightly so as to impart "top spin" to the ball, causing the shot to drop. The correct racquet position for a backhand drive straight down the line is shown in Fig. 1. It is worthy of note that the line of the arm and racquet is one. There is no bend at the wrist and spin placed on the stroke is that caused by the racquet passing over the ball.

There is a great tendency toward allowing the racquet head to drop behind the hand and the racquet-face to turn up, thus lifting the ball and causing it to slice off to the same side of the court as that from which the shot is played. This is a very serious fault, as it tends to put the ball out of court along the sideline (Fig. 2).

In Fig. 2, the broken line of the arm and racquet can be seen, while the face of the racquet is visible, showing the tilt that would cause the ball to sail high and far when stroked in this incorrect fashion.

Note that the wrist is not locked but has a slight bend, thus tending to weaken the defensive power of the stroke, and allowing the racquet to wobble badly, causing the ball to slide off the side and destroying the accuracy of the return.

Having once determined that the racquet must be held tightly, that its head must be even with or advanced beyond the arm and hand, and that the racquet face must pass over the ball and not under it in driving, we reach the actual execution of the stroke itself.

The drive is made up of footwork and racquet work, both of which must be correct to gain the maximum efficiency. If the footwork, which is but the method of gaining perfect weight placement, is wrong, the stroke loses accuracy, direction and pace, while if the stroke is wrong the correct weight placement only tends to carry the ball out of court. Coördination of mind and body are required.

The stroke, that is the racquet swing, is made up of one sweep of the racquet, during which the ball is struck. The part of the swing behind the body decides the *speed* or *pace* of the shot. That portion immediately in front of the body determines the *direction* of the shot while the end of the swing, as the racquet continues in front of the body, decides the *twist* placed on the ball. This is "follow-through," a kindred spirit to its much talked of namesake in the game of golf. If the racquet passes over the ball it imparts "top spin," which causes the ball to drop sharply. If the face of the racquet passes under the ball it "chops" the stroke or "slices" it, causing the ball to rise.

Footwork, or body position, is a far more complicated thing, and here we have the tangent of the flight of the ball meeting the circle of our swing. If the feet are placed wrong, the swing is a circle that meets that tangent at but one point. On the other hand, if the body is placed correctly and the feet follow the rules laid down for them, the swing becomes not only parallel but identical with the flight of the ball and is a straight line, not a circle.

> *THIS is the first of two articles, in which Mr. Tilden treats the game of Tennis from the standpoint of Science. He shows why it is that in order to obtain good results, a tennis player must obey certain rules which are based on the exacting physical laws of nature.*—THE EDITOR.

Forehand and backhand strokes follow the same rules for footwork; but the feet are reversed.

In all strokes the weight is shifted from the back foot to the front foot, and in all shots straight down the length of the court that shift is made at the moment of striking the ball.

In the forehand drive the weight rests on the right foot as the stroke is commenced. The feet are placed at right angles to the forehand sideline, while the body is parallel to it. The stroke travels from behind the right hip, forward on a hitting plane, about on a level with the waist. The weight is shifted with the swing and passes to the right foot just as the ball leaves the racquet (Fig. 3).

When awaiting a shot always face the net and await the stroke with the weight evenly balanced so as to allow a quick shift to either foot that will swing the body into the right angle-relation to the net. The greatest fault in footwork with most beginners and even some old tournament players, is that of stepping away from the ball (Fig. 4), thus taking the weight out of the shot and tending to lift the ball and slice it out to the side. Any step that causes the body to assume a position parallel to the net instead of at right angles to it causes the swing to be cramped and the weight to be wasted. One reason for the wonderful speed of the drives of William M. Johnston, the little Californian, is that every ounce of his 120 pounds is in every stroke he makes owing to perfect footwork.

Most players forget that the rules of footwork work two ways to produce like result at the moment of hitting the ball. For example, when a player must reach for a forehand drive he should advance his left (or front) foot to the ball and hit according to the rules given before. In this case, the line of the foot is not parallel to the sideline but the effect is the same, the body is free of the swing and the weight still travels from the right (or back) foot to the left (or front).

Conversely, when the ball is too close to the body to allow a free swing of the forehand drive, retreat the right foot and place the weight on it, thus giving the same position as in the other case, except that the body has been removed from the ball's flight yet kept in correct position to drive.

On all forehand shots (I am of course speaking for right-hand players, being one myself) the left foot is known as the front foot while the right is the back. For backhand shots this order is naturally reversed.

There are many more vital points to be considered. Service, Volleying, Chopping and Lobbing are just as interesting in their science as Driving, but unfortunately cannot be considered at this time.

Let us for a moment look at the style of the drives of our leading players. William Johnston, whom I mentioned a short way back, gains his pace and direction by a careful adherence to the laws of stroke and footwork laid down here. R. N. Williams 2nd, member of the Davis Cup team and one of the most brilliant players the game has ever seen, strokes the ball according to these rules yet seemingly defies the laws of footwork. This paradoxical condition is due to the fact that Williams knows weight placement so well that he shifts his weight from foot to foot without changing the relation of their position as do most other players. After all, footwork is but the surest way to acquire the indispensable weight placement.

Gerald Patterson, the wonderful player from Australia, is at most times a close follower of the rules of footwork, but at times, when careless or hurried he forgets, and this results in errors that seem almost inexcusable in a man of his ability. It is Norman E. Brookes' perfect knowledge of the laws of footwork and stroke that makes him at 42 still the greatest genius of the racquet.

Maurice E. McLoughlin can trace part of his sudden decline to the inherent weakness of his game due to faulty footwork on his ground strokes. Charles S. Garland, the captain of the Yale tennis team, and one of the foremost exponents of modern tennis, is an example of perfect coördination of stroke and correct footwork.

So on down the line we go, finding that the men with the sound basis for their game carry on year after year, yielding less to age than age gives them in skill, strategy and stroke perfection; while the men whose game rests solely on that unreliable rock of youth, unbounded vigor and physical violence, rather than sound scientific tennis,

Fig. 1. Correct backhand drive straight down the line.

Fig. 2. Incorrect backhand racquet position.

Correct and incorrect backhand drive position

pass from our ken, and are gone forever into the oblivion that sooner or later shrouds us all.

Tennis is in its infancy and 1919 saw the birth of a great tennis revival that will encircle the globe. Countries rising from the ashes of the fires of war, take up their athletic lives with uplifted head, triumphant over the curse of Autocracy's mailed fist, and cry "The game's the thing." France, England, Belgium, Australia, the worst sufferers of all the Allied hero-nations, send forth their Davis Cup tennis teams to meet upon the field of sporting honor. We in America had the honor to greet the great team of players and sportsmen with which Australia will defend the Davis Cup. Next year we hope to meet them once again. 1920 will see the blossoming of the flower that 1919 gave promise of to the tennis world. Let our American players, be they past, present or future, take an active part in placing America in the lead in tennis as in all else we undertake.

would be a spiral driveway running up on an easy grade, from which on either side there would be stalls inclined at such an angle as to provide easy access from the driveway. In other words, the tower would have a continuous spiral floor reaching from bottom to top so that there would be a very compact arrangement of the stalls with practically no waste space. At the center of the tower there would be a spiral leading downward, access to which could be had at intervals from the ascending driveway.

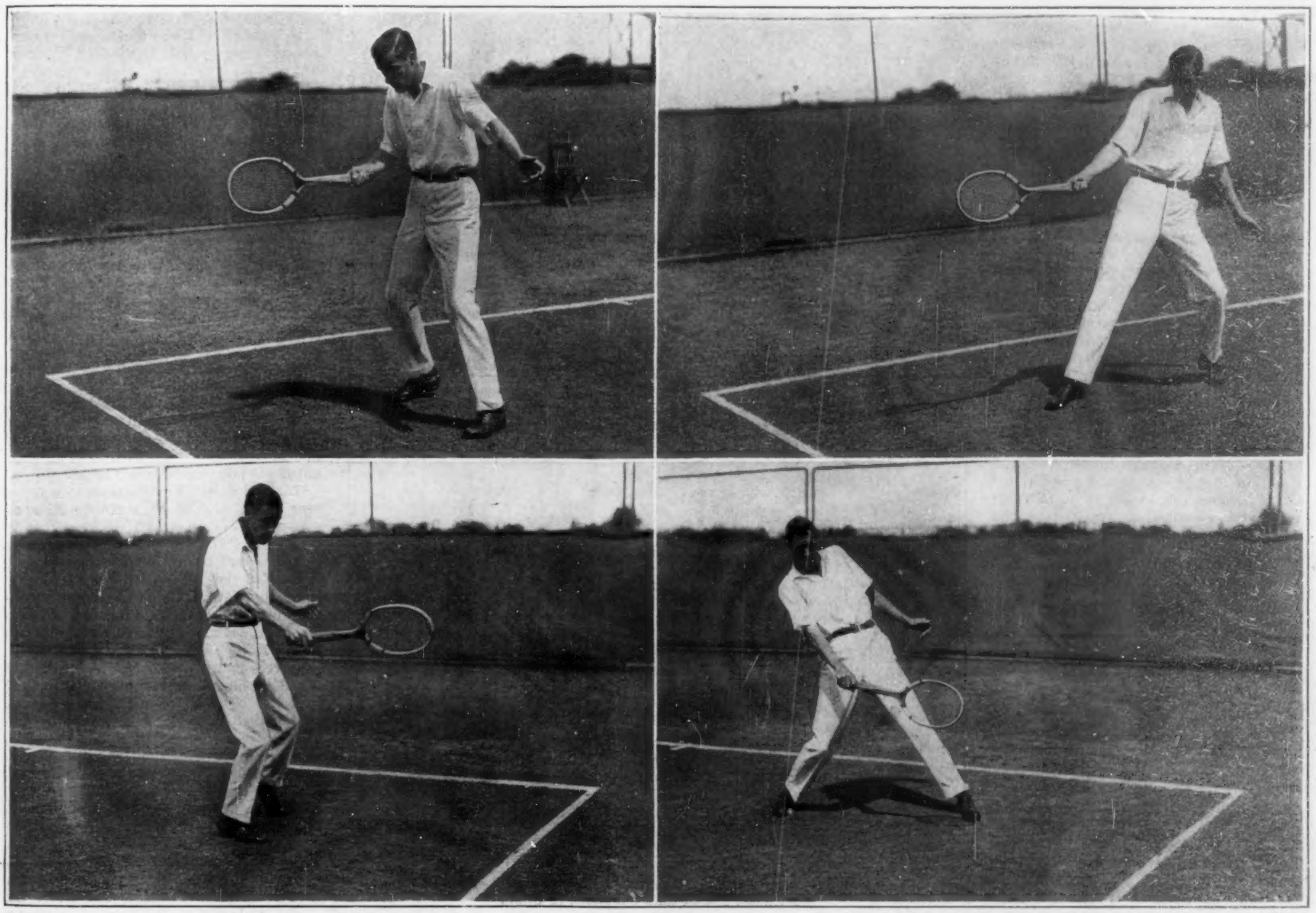
Our title-page illustration shows the proposed tower garage partly broken away to reveal the interior arrangement. The entrance to the garage is at the right hand side of the building and cars can travel continuously up to any level desired, and at each complete turn eighteen of which are shown in our picture, the car could, if it wished, pass through a connecting passageway to the descending driveway at the center and, without changing direction of travel, run down

accommodate forty cars per story, and our illustration shows eighteen stories, which would accommodate seven hundred cars. The diameter of the building would be one hundred and sixty feet and the stalls would have an average width of ten feet while the driveway would be eight feet wide.

Whether so ambitious a project will ever be constructed is a question. However, it would certainly provide ideal parking facilities for motor cars in busy cities, and a skyscraper garage would be in keeping with the tall buildings of our large cities.

Expansion and Contraction of Cement

ACCORDING to the tests made by a French engineer, M. Rohland, on the expansion and contraction of cement and concrete, it is found that when concrete plain or reinforced is exposed to the air, it contracts, but on the contrary it expands if immersed in water or even if kept in a very damp place. The contraction



Above—left: Fig. 3. Correct footwork for forehand drive. *Above—right:* Fig. 4. Incorrect footwork, forehand drive. The weight is removed from shot by stepping away from the ball. *Below—left:* Fig. 5. Correct backhand position. *Below—right:* Incorrect backhand drive.

Correct and incorrect footwork and backhand positions demonstrated by William T. Tilden, 2nd.

The Skyscraper Garage

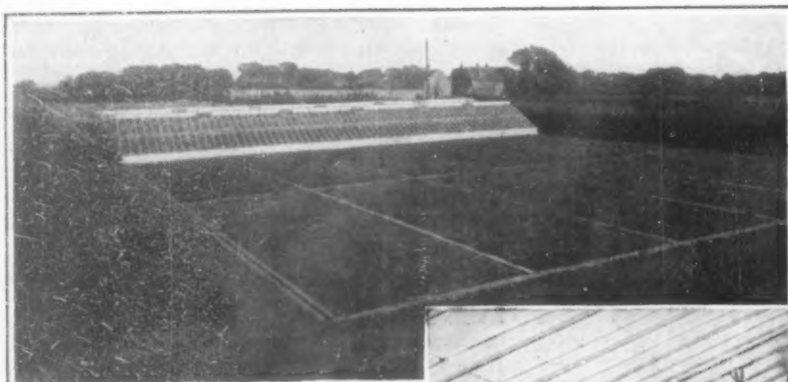
THE problem of parking motor cars is growing increasingly serious. The more densely populated the city, the more business men there are who would like to use their cars going to and from places of business, and the less space there is to accommodate their cars. Parking areas are growing smaller and fewer, while the number of cars is steadily increasing. The laws regulating the parking of cars are growing constantly more stringent. In addition to this, motor car thieves are becoming more and more bold, so that it seems as if something of a radical nature must be done soon to solve the problem of caring for cars.

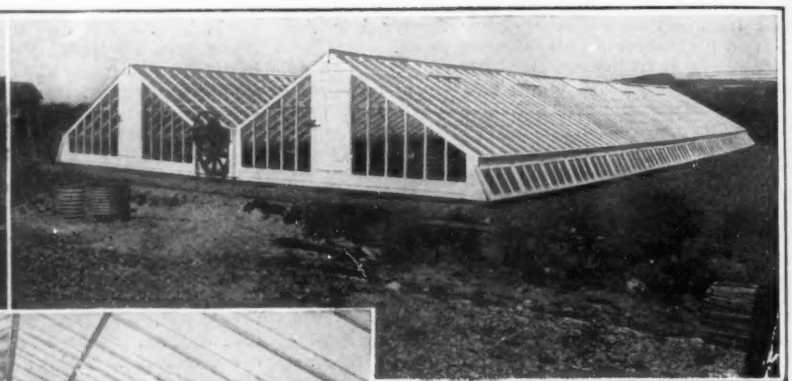
A very novel plan has been proposed by Mr. Eugene G. Higgins, of Jackson, Mich. He proposes to provide a parking space right in the midst of a business section and, because of the limitation of space, his plan is to build a garage in the form of a tower. There

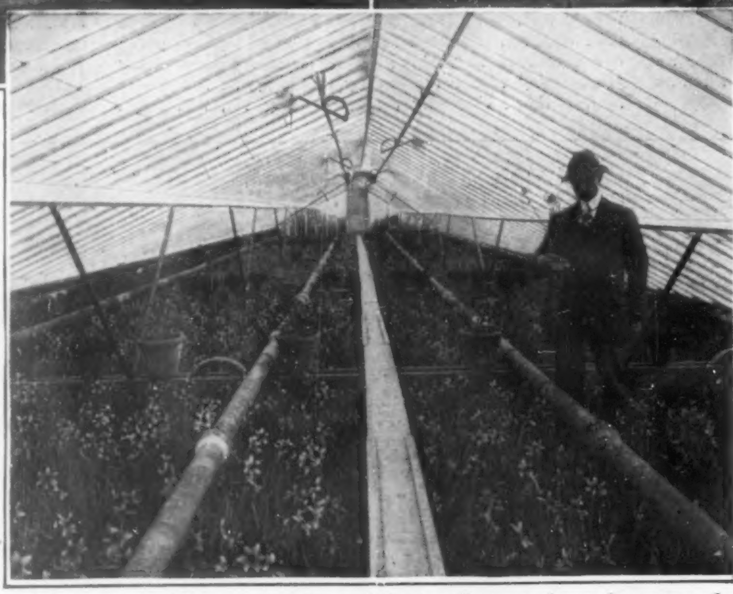
to the bottom of the tower and out at the exit on the left hand side. The ascending driveway has a three per cent grade and the descending driveway a seven per cent grade. There are elevators for passengers and from each stall there is a walk which gives access to the elevators after the car has been placed in the stall, without requiring the driver to walk out on the main driveway. Each stall may be locked so that the driver of the car after he runs his machine into the stall, may feel sure that it will not in any way be molested during his absence. On the ground floor there is room for offices and showrooms for automobile supplies, in addition to which there are waiting rooms and a repair shop.

While we may not properly speak of stories in a building with a continuous spiral, nevertheless it will be understood that by this term we mean each complete circle of the spiral. As designed, the building would

can be diminished by adding a larger amount of sand or by the use of hygroscopic salts. When powdered cement is mixed up in the first place with water, the colloidal portions separate out and absorb water, thus producing an increase in volume accompanied by a lowering of temperature. When the cement begins to set, a diminution of volume and rise of temperature ensue. These last two effects are due to the sudden coagulation of the colloidal elements, in which case water separates from the mass. In this way the process has two distinct phases; first, absorption of water with increase in volume and diminution of temperature, and second, separation of water with decrease of volume and rise in temperature. It is found that the increase in volume during the first period is greater than the decrease which takes place in the second period.







One interior and two exterior views of the traveling greenhouse by means of which a series of crops is conveniently grown in adjoining plots, to be ready at different dates

Greenhouses That Move About on Rails

FOR some years it has been realized that a movable greenhouse would be a great advantage to the gardener. Many of the crops which are planted out under glass only require the protection for a comparatively short time such as when they are in a young state or just as they are bringing their fruit or flowers to maturity. But, with a fixed structure, the crop must occupy the valuable space under the glass for the whole period of its growth.

With the movable greenhouse invented by Mr. A. Pullen-Burry, all these difficulties are swept away. Here the structure can be changed about from plot to plot just as it is needed. Pipes, boiler, ventilating gear and everything go with the structure which runs on a prepared track as can be seen in the illustrations. Although the house with its appliances weighs twenty tons, yet one lad by turning a handle can move it about from one position to another. Tall crops under the glass structure present no difficulties, for the eaves of the movable house are lifted up so that they pass over any growth.

In a photograph is shown a movable greenhouse working eleven plots. The crops grown on these included double white narcissus, Spanish iris, Emperor narcissus, Ornatus narcissus, mint, 3 plots of asparagus, parsley, white pinks, French garden crop, chrysanthemums and carrots.—*S. Leonard Bastin.*

A Chinese Cemetery Operated on the Pigeon-Hole System

A GOOD Chinaman insists on being buried in China. He may live in the United States for many years, but when he is about to die he makes it clearly understood that his remains are to be transported to the Far East for final burial.

To transport each body separately would be prohibitive in cost for the average Chinaman's estate. Hence the established procedure is to accumulate a large number of bodies until they make up a shipload and can be thus transported at a minimum expense. From the time the Chinaman dies until the shipload is being made up, his body is kept in a separate compartment of a stone structure which serves as a cemetery and which is illustrated in the accompanying view. After placing the body in its compartment or pigeon-hole, it is sealed in with a thin cement wall. Each compartment is numbered, and a suitable epitaph is written on the cement wall in flowing Chinese characters.

Copyright, Publishers' Photo Service

Chinese cemetery in Central America, showing the compartments in which bodies are stored until shipment to China

Water Tree of the Sudan

IN the Kordofan and Nuba Mountain provinces of the Sudan is to be found a remarkable tree, known locally as the Tebeldi, which is really the "Boabab" or *Adansonia digita.* These "water trees," as some term them, attain a height of fifty to fifty-five feet, and have an enormous girth of trunk up to a height of twenty-five feet or more; above this height their limbs and branches commence, and spread themselves over a large area.

The extraordinary feature of this tree is that the trunk is by nature hollow, averaging about sixteen feet in diameter. Indeed, they have been seen over eighteen feet across—sufficient if tunnelled, to permit with ease a motor-car or carriage and pair of horses to be driven through.

In this waterless tract of country the tree is mainly of value for its water-storing capacity, which is utilized in the following manner: A small hole, about two feet across, is made at the top of the trunk, and a native, getting inside through this, enlarges and improves the natural cavity, until the walls remain only a couple of inches thick. Then round the foot of the tree the earth is scraped away to form a sort of basin, which, as soon as the rains break, becomes filled with water, which is then poured from leather buckets into the cavity until full. The hole is then sealed up with mud or clay, and the supply kept for use in dry season.

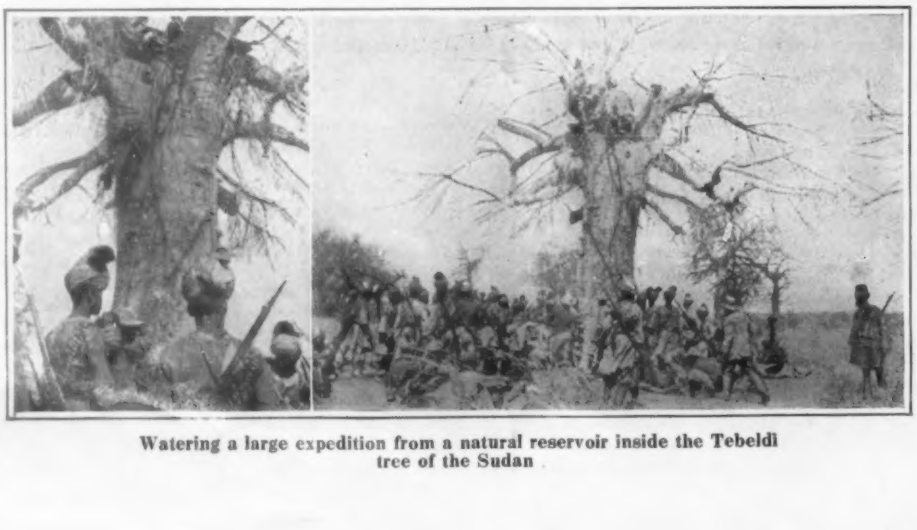
Water thus stored remains sweet for a very long time, and even after a lapse of two years only a slight discoloration is noticeable. The trees are valuable property, and are let and sold with adjacent land. On the main routes through Dar Hanr the natives make a living by selling water to travellers, the usual rate being one piastre per burma (roughly two gallons).

A great many of the trees are owned by the Government, the number and cubical capacity of each being registered. A case of their extreme utility, or rather necessity, was witnesed in 1916, during the expedition against the late Sultan Ali Dinar, of Darfur, when, at Wad Bunda, about one hundred miles west of El-Nahud, the whole of the mobile column, consisting of some eight hundred camels (each drinking ten to thirteen gallons), sixty horses and mules, and six hundred men, were watered solely from Tebeldi trees. Two methods were used, one being the ordinary native way of sending a man up the trees to get the water out by leather buckets and pass it down a rope. This was found to be too slow, and was supplemented by the system of the "siphon"—a log pipe resembling a garden-hose being inserted into the water through the hole, and the flow started by means of a pump, which was then removed, the water (continuing on its own) was poured into canvas baths, which were filled one after another.

It was suggested at first that the trees might be tapped like an ordinary beer-barrel at home; but the natives said this would split and ruin the tree, so the idea was abandoned.

However, the Tebeldi tree is not used for water storage only, as

(*Continued on page 272*)



Watering a large expedition from a natural reservoir inside the Tebeldi tree of the Sudan

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

By merely pressing the plunger, this little machine can be used for the finest embroidery work

Embroidery Machine That Fits Into the Handbag

EMBROIDERY is fast becoming a machine-made product. In fact, within recent years there has been a steady growth in the use of large embroidery looms which turn out hundreds of pieces of embroidery at one time. It has remained for a New York inventor, however, to introduce a hand-operated embroidery machine which is sufficiently compact to be carried in the ordinary handbag.

The little embroidery machine, which is illustrated in the accompanying view, is operated by pushing a plunger wherever a stitch is to be made. Its operation is so simple that it can be undertaken by a child, yet the results are excellent; indeed, the beautiful raised embroidery produced with this machine is comparable with that produced by the tedious, stitch-by-stitch, hand-made embroidery. The little machine weighs about five ounces, and is eight inches high. It can be used anywhere, because of its extreme portability.

A Window Shade That Stays Put

AMONG the seemingly simple things to invent is the window shade. Thousands of different kinds of shades have been invented, yet there are but few of them which really possess distinct merit. Far from being a simple problem, the ideal shade calls for much study and the exercise of no mean degree of ingenuity, the shade depicted in the accompanying illustrations, for instance, being the result of several years' work on the part of New York inventors.

The shade shown is designed to meet the desire and need for a distinct, artistic, and practical means of window covering. It possesses features of an attractive and unique nature. To be specific, the shade can be adjusted to cover any part of the window and any proportion of the total area. When not in use the shade can be pulled to the top of the window sash, where it is out of sight. Being properly counterbalanced by two small weights, the shade stays put in any position.

The material used for the shade proper is a special fiber, carefully pressed into a pleated arrangement. This material presents an ideal medium for the diffusion of sunlight passing through it. The guiding frame, in which the shade operates, is neat, unobtrusive, and durably constructed. It is finished to match the window casing, of which it becomes virtually a part by means of a few screws. All in all, the shade can be installed in any window with a minimum of work, and when once in place there are no unsightly chains or cords to mar the view.

Novel type of window shade that can be adjusted for any position and any proportion of the total area

Machine That Takes the Place of the Newsdealer

WHILE the idea of a coin-operated newspaper vendor is by no means new, it is only within the recent past that its application has been extended in some parts of this country. When the drafting of our young men was in full swing along about the summer of last year, the newspaper vending machines began to appear in several cities, because of the scarcity of newsboys; but now that the boys have returned to their old task, it is a much mooted question whether the machines will continue to gain in popularity.

Briefly, the automatic newsdealer is a coin-operated machine which takes a supply of newspapers and delivers them one by one, when a coin is inserted and a lever moved a short distance. A glass window permits the passer-by to read some of the headlines and to note what edition is being offered at the moment. The greatest application of the automatic newsdealer at present seems to be in remote residential sections where stores are few and far apart, but where the delivery wagons of the newspapers can call and fill the machines from time to time.

Copyright, Ledger Photo Service

To buy a paper, insert two pennies in the machine and pull a lever

The telegraphic attachment which records telephone calls that come in when there is no one to answer

Telephone That Registers Calls in One's Absence

WHEN you call friends in the next town with the intention of asking them over to tea, it doesn't make any tremendous difference whether they are home to receive your ring or not. If they are, they get the invitation, and if they are not they don't; and that is the end of it. But when you make an important business call and Central reports "They don't answer," that is something else.

Now it frequently happens that a subscriber is thus called during his temporary absence, or during that of an employee whose duty it is to attend to the telephone. If there is no response the party calling is put to the necessity of repeatedly calling the number wanted, or of abandoning the effort to establish communication. The unreasonable demand that the operator attend to this keeping of the call alive usually meets the fate which it so justly merits. Business and professional men may be subjected to a considerable loss by this procedure, as patrons who value their time will call another party rather than submit to indefinite delay. The telephone system also suffers considerable loss by reason of the time and service consumed and kept busy in repeated calls and answers by the Central operator, and the resultant loss of use of the wire.

In the effort to meet this situation a good many inventions have been put forward with the general design of notifying the intended recipient of the call that someone wants to talk with him. Usually these simply take the form of a blanket notice; the unanswered ring of the 'phone sets in action a circuit which hangs out some kind of a signal that will catch the attention of the person called when he returns. But all that such a signal can tell him is "somebody called," and he is then at the mercy of the operator. If she fails to trace the call and call it back, the system has failed.

Accordingly a California inventor has come forward with a combination of the telegraph with the telephone, in which the identity of the unanswered call is recorded. His invention depends upon the fact that, while to receive a telephone message there must be direct human agency, means are familiarly known for recording a telegram on a tape at the other end of an unattended wire. The recording telegraph is installed in the base of the telephone instrument. When the call is

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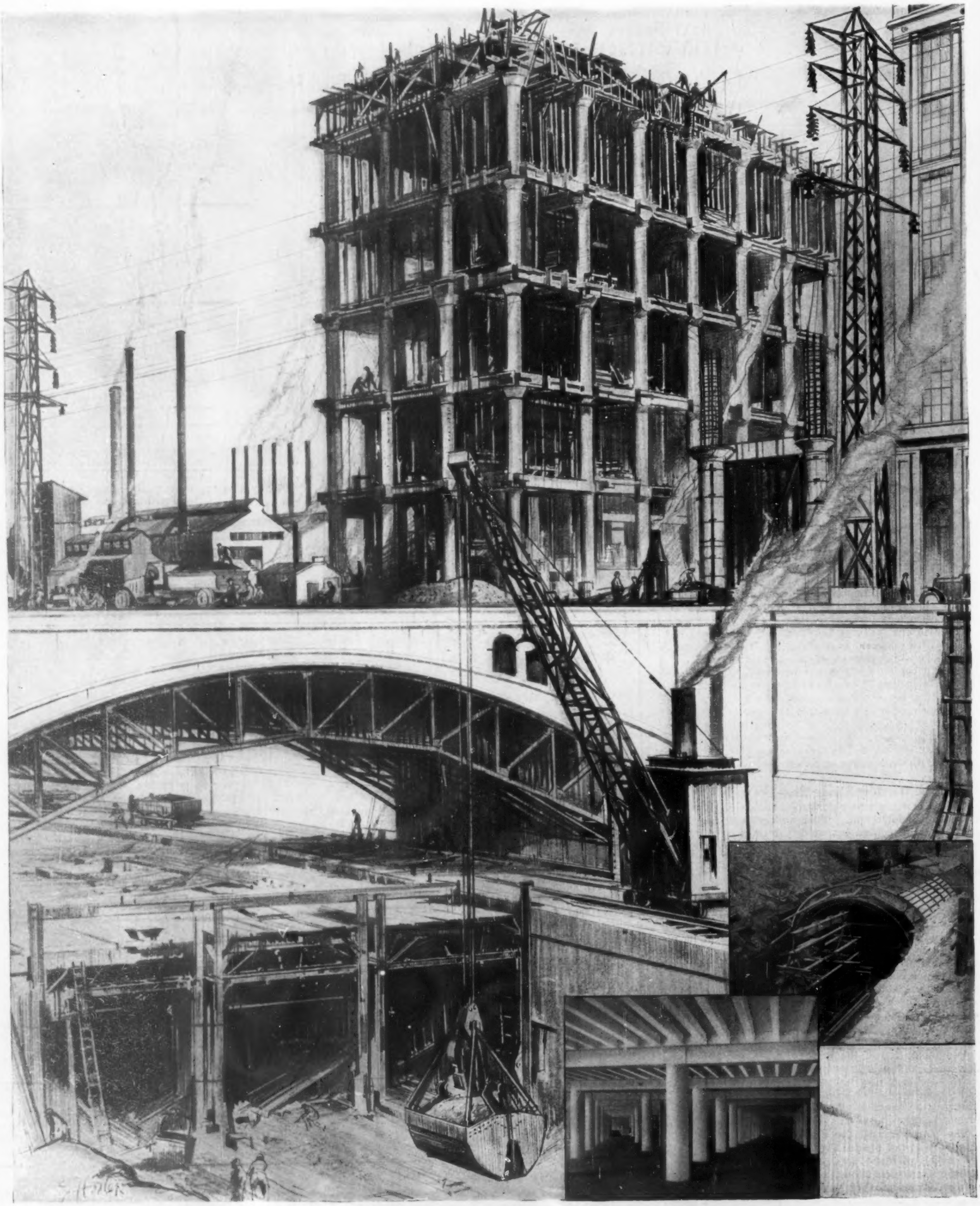
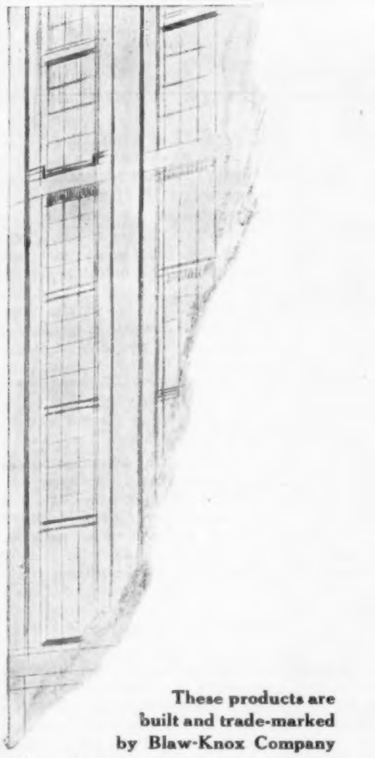




—and it will be accomplished

TO positively accomplish the purpose for which each product is designed—that is the corner-stone of the Blaw-Knox business.

To that end an unequaled service organization has been brought together.

Such words as "service", "best", and other superlatives have been used so loosely, that there is often a vast difference between what is promised and that which is delivered.

Blaw-Knox Company has been giving its distinctive type of service for years, and rests its case with those whom it serves.

Blaw-Knox Company does not believe in just doing business the easiest way. It does more than take orders and make deliveries.

Men who built the Panama Canal, the New York Aqueduct, the Los Angeles high-tension lines, the New York subways and harnessed the power of the Mississippi River; men who are producing the steel of the world; contractors and engineers who have built thousands of concrete structures from sewers to subways, from sidewalks to skyscrapers; men who have excavated or mechanically rehandled loose bulk material of all kinds—these men understand Blaw-Knox service. They have realized its worth.

The Blaw-Knox engineers first investigate and determine just what is to be accomplished. Then the equipment is produced to do that work. And the Blaw-Knox trade-mark means to you that it will fit the job and do the job, with speed and economy.

The scope of Blaw-Knox service is not limited, by time, territory nor expense. It is there to call upon at your will, like the potential power in an electric light socket.

You have a peace-of-mind when dealing with Blaw-Knox Company which saves your energy, time and money.

When you call in Blaw-Knox engineers, you have added a valuable department to your organization.

All Blaw-Knox specifications are the result of scientific study. If the manufacturing costs of Blaw-Knox products were twice as great, they could do their work no better. If they cost a cent less they could not do it so well. Everything that bears the Blaw-Knox trademark is built to do a particular job.

BLAW-KNOX COMPANY, Pittsburgh

Offices in Principal Cities — Export Representation

These products are built and trade-marked by Blaw-Knox Company

STEEL FORMS for all kinds of concrete work—sewers, tunnels, aqueducts, dams, culverts, bridges, retaining walls, factory buildings and warehouses, columns, floors, foundations, manholes, subways, reservoirs, piers, roads, sidewalks, etc.

CLAMSHELL BUCKETS and Automatic Cableway Plants for digging and rehandling earth, sand, gravel, coal, ore, limestone, tin, scrap, slag, cinders, fertilizers, rock products, etc.

FABRICATED STEEL—mill buildings, manufacturing plants, bridges, crane runways, trusses, etc.

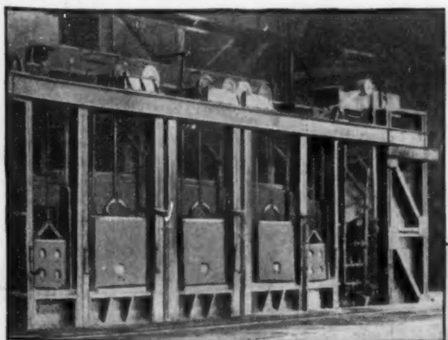
PLATE WORK—Riveted and Welded steel plate products of every description; annealing boxes; kettles; ladles; pans; penstocks; etc.

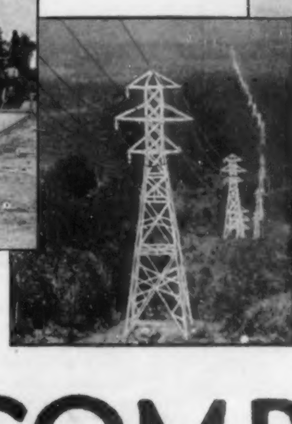
"KNOX" PATENTED WATER-COOLED Doors, Door Frames, Ports, Bulkheads, Front and Back Wall Coolers, Reversing Valves, etc., for Open Hearth, Glass and Copper Regenerative Furnaces; water-cooled standings, shields and boshes for Sheet and Pair Mills.

TOWERS for supporting high-tension transmission lines.

Blaw-Knox Company lives up to a code. The products which bear the Blaw-Knox trade-mark must do the job for which they are built. This principle is never deviated from. There is a personal interest taken in every piece of equipment or material which we provide. And that personal interest never lags. It begins with the first inquiry and knows no stopping place.
ALBERT C. LEHMAN, President.

BLAW-KNOX





BLAW-KNOX COMPANY

Recently Patented Inventions

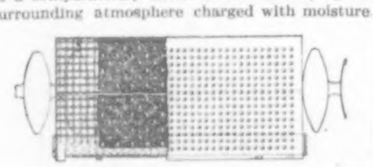
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of General Interest

CONTAINER FOR MUCILAGE OR THE LIKE.—R. F. WILLIAMS, Lake Toxaway, N. C. The invention relates to a container and distributor for mucilage, paste, or the like adapted to be made of a size for desk use, or larger for use in applying paste to large sheets of paper. More particularly the invention relates to a container which will automatically close to exclude air, and employs a drum or roller dipping into the mucilage or other adhesive material, whereby in the burning of the roller the mucilage will be carried thereon to the top to be readily available.

RUBBER SHOE SOLE MAKING APPARATUS.—P. and B. DEMATTIA, address De Mattia Bros., Garfield, N. J. Among the principal objects which the invention has in view are, to increase the effective capacity of a vulcanizing machine, to provide the vulcanized rubber and similar material from which soles of shoes may be made in forms economical in the use of the material, to provide continuous sheets from which shoe soles may be formed, arranged to form the necessary "brakes" for the shanks of the shoes and to reduce the labor factor in the manufacture of the soles.

HUMIDIFIER.—D. F. LOUDON, 109 W. 102 St., New York, N. Y. The object of the invention is to provide a humidifier more especially designed for use on steam and hot water radiators, and arranged to evaporate a large amount of water in a comparatively short time thus keeping the surrounding atmosphere charged with moisture.



PLAN VIEW HUMIDIFIER IN POSITION ON STEAM RADIATOR

Another object is to provide a humidifier which is arranged for convenient attachment to a radiator, and to permit of readily disassembling the parts and pack the same into small space for storage or shipping.

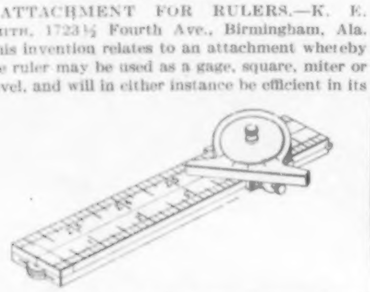
CIPHER APPARATUS.—L. NICOLETTI, Rome, Italy. This invention has for its object an apparatus by means of which it is possible to cipher and decipher messages and writings of any kind and in any language by multiple transposition of each letter and by using a number as key. The apparatus comprises a set of bars mounted parallel with each other and adapted to slide into a frame having two stationary reference numbers or parts.

SANITARY APRON.—F. C. DAVIS, 1895 S. High St., Columbus, Ohio. The invention relates to a device for use more particularly by a person needing to have recourse to a public toilet, and is designed to afford protection against infection or the contamination of the person or clothing. More specific objects are to provide an appendage to the apron at the lower end of the opening to insure complete frontal protection to the user.

FLUSHING VALVE.—W. S. WHITE, 228 15th St., Denver, Colo. The invention relates more particularly to a flushing valve including an annular chamber about the main chamber and receiving the water from the inlet to prevent one sided pressure; means to choke the outlet with the operation of the main valve, and auxiliary means to create a siphon action in a bowl or other fixture in situations where the water supply is small.

Hardware and Tools

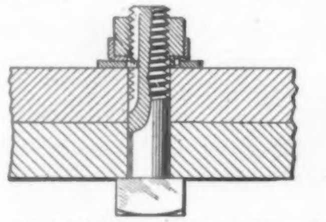
ATTACHMENT FOR RULERS.—K. E. SMITH, 1723½ Fourth Ave., Birmingham, Ala. This invention relates to an attachment whereby the ruler may be used as a gage, square, miter or bevel, and will in either instance be efficient in its operation. The attachment comprises a slide having means for engaging the ruler to clamp the slide at any desired point, and having means for varying the angle of the extension with respect to the ruler.



PERSPECTIVE VIEW OF THE ATTACHMENT APPLIED TO A RULER

INTERNAL WORK OF TUBULAR WELLS.—M. N. LATTA, Valentine, Neb. One of the most important features of the invention is to provide a pump rod which is almost equal in cross sectional area to the bore of the well casing thereby causing a complete and extremely swift displacement of the water and the conveyance of sand particles to the top. Another object is to provide a pump rod having an improved coupling which provides means for supporting particles of sand as they are worked toward the top.

NUT LOCK.—S. THOMAS, 259 Madison Ave., New York, N. Y. This invention relates to a nut lock of that type embodying a washer adapted to be keyed to the bold or other threaded member and having portions which are adapted to be upset or bent into contact with the nut to prevent turning of the latter. A more specific object is the provision of a washer made of two pieces, one of hard metal and the other of soft metal, whereby the soft metal section can be bent to engage the sides of the nut while the hard metal is keyed to the bolt or threaded member.



SECTIONAL VIEW OF A BOLT AND NUT WITH THE NUT-LOCKING DEVICE APPLIED

QUICK ADJUSTABLE WRENCH.—W. L. BESSOLO, Box 583, Walla Walla, Wash. The invention relates particularly to a wrench having engaging jaws one of which is movable with repsect to the other, the invention more particularly relating to the connection between the parts brought about by their particular construction and relation whereby the movable jaw may be quickly positioned without the necessity of rotating parts and other more or less complicated connections.

BOLT.—W. HACKETT, 324½ 10th St., Portland, Ore. This invention relates particularly to a bolt having a locking means in place of the usual nut, the object being the provision of an arrangement which will do away with nuts, as well as the time and trouble essential to their tightening, and a further object is to provide a simple arrangement which will be proof against accidental displacement.

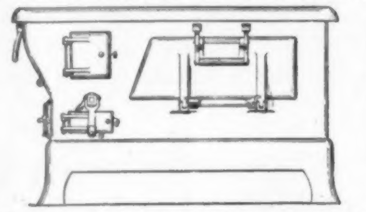
Heating and Lighting

VACUUM-BONNET.—J. H. BOYD, 142 So. 13 Ave., Mt. Vernon, N. Y. The invention relates to heating appliances and has for its object the provision of a removable bonnet or cap for a radiator valve formed with a spring seated structure which will become unseated for releasing air when the steam pressure brings the air under pressure, but it will automatically reseat itself, when the steam pressure has been reduced to a certain extent.

VIEW OF A RADIATOR AIR VALVE WITH INVENTION APPLIED

WATER HEATER.—J. L. ZACHRY, 210 Spring St., Atlanta, Ga. This invention has for its object to provide a heater of the instantaneous type, wherein a casing for water is provided, having a central flue within which is spirally arranged a pipe for supplying water, the pipe communicating with the casing near the top thereof and the casing having a burner at the bottom of the flue for heating the water as it flows through the coil.

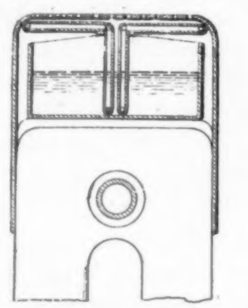
STOVE.—J. JACUCIS, address Willis E. Roe, 213 Calumet Bldg., East Chicago, Ill. The invention relates particularly to what are known as stoves or ranges, and has for an object to provide means whereby the fuel may be inserted from the end of the stove if desired, a door being provided at the end arranged with means for preventing the clogging of the grate adjacent the door.



SIDE VIEW OF A STOVE EMBODYING THE INVENTION

WATER HEATER FOR OIL STOVES.—A. E. MCCABE, 1402 Corprew Ave., Norfolk, Va. The invention relates particularly to water heating attachments, the object being the provision of a water heating casing construction in such manner as to obtain maximum results in water heating, and capable of substitution for the usual burner casing as at present used upon the burners of oil stoves.

HUMIDIFYING DEVICE.—V. A. LARSON, 5943 Calumet Ave., Chicago, Ill. This invention has for its object to provide a device of the character specified especially adapted for use with radiators of steam and hot water heating plants, for humidifying the air heated by the radiator, wherein the device may be easily placed and removed, and which will thoroughly moisten the heated air rising from the radiator.



SHOWING A SECTION OF THE DEVICE

Machines and Mechanical Devices

COUPON COUNTING MACHINE.—B. M. SNAPP, Cleveland, Ohio. The invention relates to a machine for counting coupons, tickets and the like in strip form, the general object of the invention is the construction and operation of machines of this character so as to be capable of counting at a high speed, and adapted to automatically start and stop by the insertion of the ticket or coupon srip and the discharge thereof.

METHOD AND MACHINE FOR PEELING TOMATOES.—C. KIRINO, care Tamahai & Co., Ogden, Utah (Box 418). The invention relates to a method of peeling tomatoes or other vegetables or fruit of similar form and having a skin of a nature to be readily loosened by scalding, the machine also provides for dividing the skin of each tomato into sections while on the fruit, and by subsequent steps of scalding and the removal of the skin sections, washing, cooling after scalding, topping, coring, and conveying the tomatoes to the point where the operations are to be performed.

Prime Movers and Their Accessories

MIXER.—J. H. DENNER, 154 National Ave., Detroit, Mich. The invention relates to mixers for internal combustion engines, the object is to provide a device adapted to be arranged between the carbureter and the engine in the intake manifold to thoroughly break up and revaporize the charge drawn toward the engine from the carbureter and to insure the more perfect combustion and increased power with the same amount of fuel.

FUEL VAPORIZER.—B. J. PYE and H. RABBES, 112 Market St., San Francisco, Cal. The object of the invention is to provide a device especially adapted for use with internal combustion engines. The device consists of a heater and volatilizer adapted to be arranged between the carbureter and the intake manifold and comprising a suitable support having an opening for registering with the opening of the manifold, an electrical heater on the support, and a rotatable element carried by the support and adapted to be rotated by the passage of the fuel.

Railways and Their Accessories

RAILROAD TIE.—J. O. DAVIS, 831 E. Moses St., Cushing, Okla. The invention relates particularly to composite ties the object being the provision of a tie formed of structural steel and concrete so arranged as to provide for the ready introduction of the plastic material in connection with the metal, without the necessity of forms, molds, and the like. A further object is the provision of a tie, the parts of which are so arranged as to provide for the reception and ready securing of cushion blocks upon the rail seats.

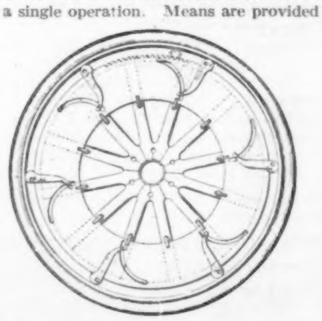
LOCOMOTIVE GRATE.—W. F. HAUN, 767 Penn St., Meadville, Pa. This invention relates generally to furnace grates, and particularly to shaking grates, the object being the provision of a grate for use in connection with locomotives which will permit the fire box to be perfectly cleaned, in much less time and with greatly reduced labor as compared to the present possibilities whereby to effect a decided saving of time, coal and water.

Pertaining to Vehicles

TRACTOR ATTACHMENT.—M. L. ADAMS, 910 Stewart St., Seattle, Wash. The invention relates more particularly to a tractor attachment for an automobile. An object is to provide an attachment adapted to be mounted upon the rear or drive axle in place of the usual wheel, the mounting being such as to permit a certain degree of oscillation of the tractor attachment of the axle to overcome unevenness in the ground over which the automobile is moving.

RADIATOR PROTECTOR.—A. L. MAPSON, Granada, Minn. The object of the invention is to provide a device which may be easily and quickly applied to the radiator of an automobile and having movable protecting shutters capable of being opened or closed from the driver's seat, wherein means is provided for taking up the wear on the trunnions of the shutters, so that there will be no loose movements in the working parts.

DEMOUNTABLE RIM.—J. N. FOSTER, care Goldstein & Miller, El Paso, Texas. The invention relates to demountable rims for vehicle wheels, it has for its object to provide a rim which may be locked to the rim or unlocked therefrom with a single operation. Means are provided for locking the rim from lateral movement, and means for controlling the locking, the means comprising levers pivoted to the felly and having cam heads for engaging the demountable rim the moving means for the levers comprising a cam ring mounted to rotate on the wheel.



A SIDE VIEW OF A WHEEL WITH INVENTION APPLIED

Designs

DESIGN FOR A FLOWER HOLDER.—G. E. M. STUMPP and K. KAMMANN, 761 Fifth Ave., New York.

DESIGN FOR A BOTTLE.—O. O. R. SCHWIDETZKY, Hasbrouck Heights, N. J.

Rolling Stock of 1919

(*Continued from page 251*)

change with variations in the slope of the locomotive. This point is about 16 inches ahead of the combustion chamber tube sheet.

In addition to the usual blower, the fire may be urged when the engine is standing by means of a smoke lifter, consisting of a steam pipe, visible in the illustration. This pipe leads to a hollow bead around the top of the smokestack. In the head are twenty quarter-inch drilled holes. Steam from these holes will cause the smoke to rise from the stack without overstimulating the draft through the flues. The smokestack is of unusual size, the diameter being no less than 3 feet 2 inches. As the height of the stack could not be increased to get the proper ratio between stack diameter and length, the outer shell is cast in four separate passages with extensions continued down to the center line of the boiler. These extensions are immediately over the four exhaust nozzles—a nozzle for each cylinder, and thus the great volume of exhaust steam from the four cylinders has a free exit, thereby reducing back pressure and increasing the efficiency of the engine.

Other refinements of design in this locomotive are found in the axles, crank pins and piston rods, which are of hollow cross-section; and the main and side rods are of deep I-section with thin webs. This is to secure the lightest possible weight for maximum stresses.

The tender has a water capacity of 13,000 gallons and carries 14 tons of coal. The total wheel base of the engine and tender measures 97 feet 3¾ inches.

A report of the performance of this remarkable locomotive will be awaited with interest.

Turning now to the three examples of all-steel express and coal cars shown in the accompanying figures, we find new types just built by the Pennsylvania Railroad. The express car has a remarkably neat appearance and was designed principally to take care of the traffic handled at present on the Pennsylvania in 50-ton steel box cars of the X25 type and at the same time be suitable for baggage, express, mail-storage or parcels-post shipments in regular passenger service. The car has the general outside appearance of the X25 class minus the running board, ladders and vertical brake masts; but with four side and two end doors of the standard baggage car design.

The coal cars are some of the largest in the world and are of a new design just completed at the Pennsylvania's Steel Car plant. One of the giant structures, No. 306,001 is of the gondola type with drop doors. It weighs 74,600 pounds and has a capacity of 220,000 pounds or 110 tons. The other car is known as Class H26 and is numbered 173,001. It weighs 83,600 pounds with a capacity of 210,000 pounds or 105 tons. Both are carried on 6-wheel trucks of special design to support these great weights.

In conclusion it may be recalled that a few experimental coal cars of similar design and capacity were built for the Virginian Railway in 1917.

The Romance of Invention—II

(*Continued from page 252*)

from the source, through the condenser, the film and the projection lens, to the screen, must be cut off and turned on as often as the film moves forward, otherwise our eyes would see not only the stationary picture which, combined, makes what appears to be a picture in motion, but would also see the image of the film moving from bottom of the screen upwards. To accomplish this cutting off and turning on of light there is a rotary shutter—a disk with slots in it. Now, the larger these slots, and the less the metal between

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The Romance of Invention—II

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them, obviously, the more light gets to the screen. But the relation of "time open" to "time closed" is dictated entirely by the time which the film is stationary. The longer units of time the film remains still and the less the units of time the film moves in the teeth of the intermittent motion, the more light can be thrown through and the brighter and better the picture. But on the contrary, the shorter the time the film is stationary, and the longer the time of exposure, the more smoothly can the intermittent motion be made to run. Those mechanisms which provide the longest exposure and the quickest jerk to the film wear out faster than those which split the time available up more evenly. Hence the better the machine the faster it wears out.

The moving picture industry is the only one in the world which has a world-wide standard. Picture film will fit, be it in Honk Kong or Iceland, the Fiji Islands or New York. And it is the only universal language; pictures made in France are understood here—unless they require too many conversational panels—and those we make delight audiences of Koreans or Hindus. And is there any other institution in the world which is at once an amusement, a news distributer, a means of education and a tool of the laboratory?

Now as just a final curiosity, consider this: the moving picture has absolutely fixed limits at the present moment, because of this sixteen per second requirement. True, pictures can be "raced through" much faster; also special cameras are made which can take pictures at many times that speed—pictures which, when projected at normal speed, "slow up" fast motion so that we can study at leisure the kick of a horse or the twist of the wrist of a golf player. But the limits are there, if elastic; film cannot be started and stopped, started and stopped beyond a certain speed, without ripping the film to pieces, and the life and endurance of the necessarily tiny intermittent-motion gear parts are also fixed quantities.

A Dream for the Future

Hence the search for the continuous-motion picture projector—one which will feed the strip of motion picture film smoothly and evenly, yet project from this smoothly moving strip a stationary image. Although it was the continuous movement which came first (the kinetoscope had such a movement) it was the intermittent motion which made *projection* possible. And now inventors the world over are working to secure a continuous movement which will be as effective so far as projection is concerned. Such a projection or camera (the two are the same in principle but merely reversed for use) would at once be able to increase the speed of making such pictures so that in place of the present thousand pictures per minute, twenty-five or, perhaps even fifty thousand pictures might be made in the same time. The service this would render in the analysis of swift motion is hardly to be depicted in an article, let alone a sentence. The service it would render the industry in the avoidance of wear and tear on the film, the final banishment of "flicker" and the minimizing of fire danger (by using less light and consequently less heat), not to mention the saving in worn-out intermittent motions, can hardly be estimated.

Mr. Jenkins has been working on the problem for some time. In an entirely new way, which involves a completely new development in optics so revolutionary and yet so simple that the wonder is it hasn't been thought of before, he hopes to accomplish what many have declared to be impossible.

If Mr. Jenkins said this himself one might perhaps make mental reservations on account of the enthusiasm of the inventor. But this new optical apparatus is being developed under his supervision at the Bureau of Standards and that erudite and progressive institution does not usually spend much time in chasing rainbows.

The SCIENTIFIC AMERICAN has the promise of the story as soon as the device has been completed and tested (preliminary and experimental tests have already been made).

Meanwhile, the industry, in spite of its mechanical and chemical limits, continues to grow with speed and effectiveness. It is making a place for itself in all sorts of schools, teaching things that cannot be taught otherwise; surgery, for instance. It is being used to expand the capacity of the individual teacher. An instructor in mechanical drawing can actually demonstrate to only as many as can crowd around his table and small instruments; with a moving picture demonstration he can just as easily teach a class of a thousand or more. Its services in the teaching of geography, history, current events and science in primary schools need no mention here. It is preserving for posterity not only the likenesses but the actions of the great men of our time. It puts in the archives of governments events which otherwise would soon be remembered as fables. What it will mean to the historian of the war just passed, when that war is written in the perspective of fifty years from now, can only be guessed. It is the amusement of millions and the pleasure of the world.

And it sprung from a small wheel, a slot, and the idea that the film must start and stop, start and stop; and the first practical machine to accomplish it made a lot of people rich, but not the inventor. But—"I should worry," says Mr. Jenkins. "Wait till the continuous motion machine is completed. I won't sell *that* patent for any $5,700."

New Worlds to Conquer

(Continued from page 254)

next kilned to a temperature 400 degrees in excess of the highest pouring point of the metal which is to be molded in it. This finishes the mold, which is now ready for use. Metal shrinkages have been taken care of in a surprising way; but in many patterns sand cores must so far be used to meet concentric shrinkages, in many others permanent copes are used with sand drags, while in a few cases the new material has not been employed successfully. Nevertheless, when we are told that more than a thousand castings have been made in the more difficult metals from a single mold, and that this showing is by no means an exceptional one, we must realize that we are in the presence of a thing of promise.

When fused by oxyacetylene heat or electric arc and roughly molded in open molybdenum forms, the asbestos has been fashioned into cutting points of high efficiency. The finely ground material makes an excellent polishing medium for woods and metals, and even has been used for cleaning the teeth. It mixes well with soap as a hand detergent; it cleans dishes in short order; it has been used with excellent results on windows. As a polish for jewelry a keen demand is anticipated. Plastic pipe-coverings of the amphibole mixed with special binders of various forms have stood up very well.

There seems to be no particular reason why asbestos should have been considered of main value as a woven fabric. Apparently the fact that it could with such conspicuous ease and success be made into a fire-proof woven goods has blinded us to other possibilities inherent in its use.

Our Technical Achievements in the Great War—VII

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lished when we declared war on so large a scale as that of smokeless powder, but

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Our Technical Achievements in the Great War—VII

(*Continued from page 268*)

our output at the close of the war was over 40 per cent larger than Great Britain and nearly double that of France.

Toxic or "Poison" Gases

When we entered the war we had practically no experience in manufacturing toxic gases and no facilities that could readily be converted to such use. At the armistice we could produce more gas than France, England or Germany. The Government found it necessary to build its own plants and to finance certain private firms. The majority of these plants were built at Edgewood Arsenal, on the American Proving Ground, Maryland. The accompanying diagram shows the production in short tons each month.

A full description of this remarkable enterprise was given in the SCIENTIFIC AMERICAN of March 29, 1919, to which the reader is referred for full particulars. For other details than those above given of our great effort in artillery reference is made to articles published in our issue of April 5, 1919.

Tractors and Tanks

When we entered the war no suitable designs existed for medium, heavy artillery tractors; but new 5-ton and 10-ton types were perfected in this country and 1,100 were shipped overseas before November 1, 1918. About 300 larger tractors also were shipped and 350 more secured from the French and British.

By the armistice we had produced 64 6-ton tanks and our rate of production is shown by the fact that by March, 1919, we had completed 778. We made use, in active service of 227 of these tanks supplied by the French.

In the matter of heavy 30-ton tanks, the work was done on a coöperative plan, we furnishing the Liberty motors and the driving mechanism and the British the armor plate for 1,500 tanks for the 1919 campaign. For immediate work in France this country received 64 heavy tanks from the British.

Our Artillery in France

The most important single fact about our artillery in France is that we always had a sufficient supply of light artillery for the combat divisions that were ready for front-line service. This statement means that when divisions went into the line without their artillery it was not for lack of guns but rather because it takes much longer to train artillery troops than it does infantry and so, under the pressure of battle needs in the summer and fall of 1918, American divisions were put into line a number of times, supported by French and British artillery or without artillery.

The statistics show that in every 100 days that our combat divisions were in line they were supported by their own artillery for 75 days, by British artillery for 5 days, by French artillery for 1½ days and were without artillery for 18½ days out of the 100. Of these 18½ days, however, 18 days were in quiet sectors and only one-half of one day in active sectors.

We may summarize by saying that we had in France 3,500 guns, of which nearly 500 were made in America, and we used on the firing line 2,250 guns, of which over 100 were made in America.

Guns Needed Compared with Guns Available

The situation as regards the equipment of our army with artillery is further made by the diagram showing the men and the artillery available each month.

The upper white line shows the size of army that could have been fully equipped each month with the pieces of light artillery that were actually available. If the supply had been fully available this line would run somewhat above the upper black line, to allow for an adequate reserve and for the retirement of the less satisfactory types of guns.

So also the lower black line shows, for each month, the size of army that could have been equipped with the proper number of pieces of heavy artillery of calibers greater than 3 inches. These tables call for more heavy artillery for a given number of men than the British, French or Germans actually used, and much more than had ever been thought advisable before this war.

Salvage by Floating Towers of Concrete

(*Continued from page 257*)

A rope of steel is to be suspended between two powerful tugs, so that it forms a loop between them, dragging on the seabed. By slowly steaming the tugs across the vessel the direction and general position of which has previously been determined by line soundings, it is hoped that it will be possible to hook the steel rope under the hull of the wreck. This accomplished, the free ends of the rope will be supported by buoys and a second rope attached in the same way. This is to be continued until the full number of ropes to take the weight of the vessel and its cargo have been got underneath it. Care will be taken that the weight is distributed as evenly as possible between the various ropes, as a vessel which has been torpedoed is scarcely in a condition to withstand any excessive strains in directions not allowed for in the original designs. When sufficient hawsers have been laid in position in this manner, two, or in the case of larger ships, four, of the salvage towers will be towed up so as to be above the wreck to each side. In the case of a large vessel, two towards the bows and two towards the stern will be used. The buoyed up ends of the hawsers will be taken aboard the salvage towers and made fast to the winches. Water will now be admitted by the sluices until the towers sink right to the bottom, their "stepped" shape enabling them to sit close under the submerged vessel, and their great height ensuring that in many cases their tops will just project above the surface. Where the depth is too great even for this, it is possible that arrangements may be made for closing-in and wholly submerging these tops. The hawsers will then be drawn tight, and additional lashings provided to preserve rigidity if necessary. Pumping vessels will then draw alongside and as the water is removed the giant floats will regain their buoyancy, lifting the wreck with them. Their balance will be maintained by adjusting the admission of water to the cellular walls as required. Since the "mystery ships" are said to draw only about 12 feet of water when unladen, it will be seen that, even when burdened with a fully laden wreck, they will still be able to rise very high out of the water. So the sunken vessel will be raised to a position where it may be patched and rendered temporarily seaworthy. As a torpedo does not usually effect a large external rent in a ship's side this will be the most general procedure, but where the damage is too severe to repair (even temporarily) in this way, the whole flotilla may be towed to safety by auxiliary tugs. The pointed shape of the "mystery ships" renders this more easy than a rectangular design would do.

It is further suggested that in the event of a salvage tower requiring repairs or cleaning, it could be canted over sufficiently by flooding the compartments of one side, to enable all minor repairs to be done out of water. More serious repairs are to be carried out by raising the damaged tower on two of its sisters. By putting them on either side, the tower could be raised bodily quite clear of the sea.

Whether these huge structures will meet

(*Continued on page 272*)

HARRISON *Original Hexagon Cellular* Radiators

Salvage by Floating Towers of Concrete

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with success remains to be seen. At all events, it will be acknowledged that their conception is original and daring in the extreme.

Water Tree of the Sudan

(Continued from page 260)

from its bark the inhabitants make strong and serviceable ropes, which are used by them for roping camel-loads, building their houses, and, in fact, for anything that needs tying up or binding.

In the rainy season the Tebeldi is covered with leaves not unlike those of the sycamore, and affords excellent shade and coolness, an asset by no means to be despised in Africa. It has a large white cone-shaped flower with a red center, but no smell; later on it bears fruit in the shape of a large nut about six inches long and two across, greenish brown in color. Inside the outer shell are about thirty or forty smaller nuts clustered together, each with its own kernels; they are covered with a white powder and are bitter to the taste, with somewhat of an almond flavor. They are used during Ramadan by the natives as a sort of cornflour, being crushed, mixed with water or kisera, and then boiled and eaten. From the smaller outer shells the Nubas make snuff-boxes, which are worn round their waists.

The age of the trees must be very great, running into centuries. One planted twenty years ago is still tiny—only about four inches across. If one asks the sheikhs and natives (some of them very old), the reply is always the same: that they have never seen any difference in the trees; it is now as it was when they were boys, and much the same in the days of their fathers before them.—*H. J. Shepstone.*

Telephone That Registers Calls in One's Absence

(Continued from page 261)

not answered the operator plugs the telephone reciever out and puts the telegraph into the circuit. Then she delivers over the line, in the regular Morse code, any message which the caller gives her, and this message is recorded on the tape in the base of the telephone. Then when the absentee returns, the first thing he does is to look at the tape, to see whether any message has arrived in his absence, and immediately, with the aid of the code card supplied with the apparatus, he spells out the information that Main 7007 wants to talk with him. In this way the possibility of calls being lost through the absence of the party called can be completely eliminated.—*Seline Hess.*

Sweet Potatoes the Year Round

GOOD, sound sweet potatoes, available the year round, are in prospect, consequent on present extensive construction of curing and storage plants in various parts of the South, particularly Texas, and in California. Heretofore the consuming season has been of comparatively short duration, ending about New Year's. Kept in ordinary cellar storage and brought out after this date, sweet potatoes quickly break down, and such heavy losses occur that the sweet potato industry has grown a crop usually which could be marketed and consumed by the New Year. The economic importance of the sweet potato indubitably has been seriously reduced by this limitation. With the perfecting of curing and storing methods making year-round sale practical, the question of the sweet potato's future assumes interesting aspects. The total United States sweet potato acreage the past three years has ranged from 774,000 to 922,000. The production in 1918 was 86,334,000 bushels. Revolutionary expansion in the industry, as a result of an extended consuming season, is certainly a possibility.

In the curing and storage plants recently built or now building, various systems are incorporated. Possibly the best known was developed by a Southerner with experiments of the United States Department of Agriculture as a basis. This system is so popular in Texas that one marketing organization alone, expects to control the coming season over half a million bushels of storage space in it. The same system is being used in a curing and storage plant at Turlock, California, which is called the biggest of its kind in the world. Its capacity is 100,000 bushels.

The process is not complicated. The sweet potatoes are placed in bins 6 by 6 feet with latticed sides. From pipes in the floor to ventilators in the roof dry air at 85 to 90 degrees is forced through the potatoes by motors and fans. This is kept up for ten days, when the temperature is reduced to 55 degrees. When the curing process is completed, the potatoes can be taken out and stored in common bins.

The effect of the curing process is to toughen the skin and outer layer of each sweet potato. The weight shrinkage is nominal—four to six per cent. In the case of infected potatoes, the process seems to have the effect of greatly retarding the progress of the disease. Potatoes thus cured will keep in excellent condition for months.

The process is not particularly expensive, it would appear. The Turlock, Cal., curing and storage plant, with its enormous capacity, cost about $75,000. To operate it, a force of 20 men is required for about 90 days a year, while a superintendent must be employed the year round.

In several directions, as suggested, this new development in the sweet potato industry has significance. It indicates better marketing conditions for growers, for instead of having to dump a crop on the market immediately after digging they may cure and hold until a favorable moment. No sweet potato growers ever made such handsome profits as those who in 1918 were able to avail themselves of curing and storage facilities.

It suggests, further, radical expansion in the annual crop. In fact, this expansion, based on curing and storage plants, has already begun. At one point in Texas, Longview, where the curing system has been installed, the annual crop has grown from 30,000 bushels to 200,000 bushels. Expansion naturally bears an intimate relation to consumption, but with the sweet potato available over a much longer period a decided increase in the latter would seem inevitable.

Varnished Raisins

MUCH of the nutritive value of raisins is lost by washing them. In the drying process the skin of the raisin is cracked which results in the sugaring of the pulp. When the raisin is washed the valuable grape sugar is dissolved and thrown away; and yet we would not advise the good housewife to refrain from washing the fruit.

Another way out of the difficulty is to use raisins that have been treated to prevent sugaring. Mr. Samuel Katzprowski, a Russian inventor living in Berkeley, Cal., has developed a process of dipping grapes in a solution of glucose. The solution is kept close to the boiling point and the grapes are immersed for from ten to twenty seconds so that they are covered with a coat of glucose. Then the grapes are dried in the usual way and the glucose forms a tough, glossy envelope that completely seals the raisin, preventing the skin from cracking. Raisins may also be dipped, but they must be heated after treatment to evaporate the water of the glucose solution.


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